POWER

A McGRAW-HILL PUBLICATION—ESTABLISHED 1884

ELY C. HUTCHINSON, *Editor*

Volume 72 NEW YORK, AUGUST 5, 1930 *Number 6*

The Benefits of Association

PRACTICALLY every profession or calling has its association or society. It is the organized expression of the art or vocation which it represents, the correlation of the efforts of its members for greater effectiveness.

One of the first returns to an adherent is the appearance of his name in the roster as an accepted and recognized member of the craft. It gives him identification and standing. The membership list of a reputable society is a directory of the leaders in its subject. One of the first moves in evaluating a man is to see if he is a member of the leading society in his profession.

And then there is the opportunity for broadening one's acquaintanceship, the making of friends whose work and interest are in line with his own.

And a wide circle of friends and acquaintances is one of the best assets that a man can have.

One of the advantages for which one most naturally looks is ideas and information that will be of value to him in his work. This he gets in the papers and lectures presented at the meetings and in their discussion. Often opportunities are open for obtaining solutions to his own immediate problems or suggestions for improvement in plant or practice.

And participation in discussion not only broadens his ideas and widens his mental horizon, but also accustoms him to thinking on his feet, gives him confidence in speaking and the ability to get his thoughts over convincingly and to make his point interestingly.

Many of the societies publish proceedings, transactions, etc., which contain the foremost thinking of the leaders of the profession and constitute a record of progress and achievement. Many also have periodicals which keep the member who reads them informed of the news and development and the movement of the leaders in his business.

But the most of these advantages come from active participation in the meetings and work of the society. Simply to join and pay one's dues brings some of them. Passive attendance at the meetings brings more. But the one who gets the most out of his membership is he who takes an active, intelligent interest in the proceedings, who wants to know and wants to help, whose willingness and ability to assist lead to his enlistment in committee work, a more intimate and dominant association with his fellow workers, and reputation and advancement in his calling.

As has been often said, the more one puts into his society the more, and in multiplied measure, he gets out of it.

F. R. Low

EDITORIALS

Courts Differ on Instalment Buying

THE RIGHT of a municipality to contract for the purchase of power-generating equipment on the basis of monthly payments, to be met out of revenues from the plant, has been denied by two recent state Supreme Court decisions—one in Idaho and the other in Iowa. In the one case it was held that the town had exceeded the specific powers conferred upon it by the Legislature, whereas in the other case it was held that the limitations of indebtedness had been violated without assent of the electors.

On the other hand, a very similar case last fall in Texas was decided in favor of the equipment manufacturer who solicited business from municipalities on the instalment plan. Thus it would appear that states are not in agreement on such issues.

Instalment buying has proved an attractive means of modernizing many small town power plants, particularly in the West and Southwest, without the necessity of putting through local bond issues. Inhibition of the practice on legal technicalities in the two cases cited emphasizes the handicap of municipal dealings as compared with transactions between private parties.

Where Will It Stop?

FIRST, where did it start? Some say, with the stock market, but it was earlier than that. The period of steadily declining business preceding the cataclysm of last October meant something, although unrecognized by many experts. The fact is, it is simpler to trace the consequence of a decline of trade than to definitely sense its inception.

It can easily be seen now that the condition is world-wide. Business in Germany has declined to less than 50 per cent of normal, and efforts to get into line by readjusting wages in industry are being made. So far there has been no success.

Meantime, Switzerland is not selling the usual embroidered undergarments to Japanese women because the United States is not taking its usual supply of raw silk from Japan this year. Nor, as a result of the Ghandi uprising, does Switzerland find her usual market for cotton fabrics in India. All of which simply illustrates with present-day examples the oft-repeated point that prosperity is decidedly an international affair.

We of the United States are greatly blessed by the comparative self-sufficiency of our home markets. Nevertheless, we do enough export business to feel the effect of low prices from European competitors.

The modernizing of European manufacturing establishments and the preparation for lower production costs now proceeding in the face of poor business conditions should be heeded by American industry. Old equipment in the boiler room, engine room, or factory will not produce goods at the new prices seemingly on the way.

Where it will stop, at least from the international view, is not now easily answered, but the wisdom of complete preparation for closer price competition has never been more apparent.

Condenser Tube Deterioration

EVER SINCE the condensing power plant came into existence operators have been troubled with condenser tube deterioration. With some condensing water, tubes have lasted only two years. Even those plants using exceptionally good water have had to retube condensers occasionally.

Finding a cure for this trouble has, in the past, largely been left to the metallurgists, who, by developing new alloys and refining the grain texture, have achieved some measurable success. In many instances condenser tube life has been more than doubled, but even with this improvement tube deterioration is still costly.

The A.S.M.E. special committee on condenser tube research has reached the conclusion that bad water and tube material are not alone responsible for the deterioration of tubes, and that entrained air and turbulent conditions of circulating water are important factors.

Investigations of the effect of these factors may yield information that will shift the burden of improving condenser tube performance upon plant, pump, and condenser designers. Work already accomplished indicates that large volumes of entrained air are present which appear to enter the system at the circulating water pump shaft glands and through a vortex in the pump suction.

This committee deserves the whole-hearted support of both manufacturers and operating companies in its effort to determine the source of air infiltration, its effect on condenser tubes, and ways of eliminating it.

An Investment

Air Conditioning

JULY AND AUGUST are the months of vacation. Thoughts center on the outing that is past or about to begin. During this period of the year business generally functions at a slackened pace and the vitality of the average worker, mental or manual, is at lowest ebb. Fifty weeks of strenuous effort have had their effects on the physical well being. Depending upon the individual, a rest, change of environment, activity in the fresh air and sunshine, or perhaps all three of these health builders in judicious proportion, are in order.

From the economic standpoint industry has recognized the advantages accruing from a period of rest from the regular routine. Observation has shown that a vacation properly spent improves the individual physically and mentally. The benefits to him are immediate and indirectly are reflected in his work throughout the year.

In this way the employer has a direct interest in how employees spend vacations. Two weeks pay without direct return is his investment. What the employee does with his leisure time, therefore, is of mutual concern. How to get the greatest good from these weeks of freedom is the question to be solved. Tastes vary, and likewise hobbies. Each individual should, and probably will, do that which gives him the greatest pleasure, something entirely different from his occupational pursuits that complies with the laws of hygiene and health. The only rule that commonly applies is moderation.

A vacation wisely spent is an investment in vitality.

Traditional Accounting Handicaps Engineering

ENGINEERING PROGRESS is at times seriously handicapped by accounting conservatism, which leads to the thought that the accountant's ideas of depreciation need modification if power engineering is to show the same advances as has strictly production engineering.

Depreciation should cover the wear and tear of a machine, but, most vital of all, it should embrace the obsolescence. Unfortunately, the average accountant considers only wear, and as this is slight, save in unusual cases, a piece of power plant machinery is assessed a depreciation charge based on a life far beyond that during which it can be termed efficient when compared to newer machines.

Management may realize the growing obsolescence, but will insist on continuing the old-fashioned equipment in service until the capital account is balanced by the depreciation fund. Management insists upon basing its action on the machine life, ignoring the factor of useful life. It is not surprising, then, that long-established industrials find their power costs excessive compared to that in factories more recently built or modernized.

The solution of the problem calls for an entirely different method of charging off the capital account. The automobile insurance companies follow a plan of present value which might well be adopted by owners of power plant machinery. The insurance companies, in writing fire and theft policies, assume that the automobile suffers a high depreciation in value during the first year, the amount of value shrinkage decreasing each year, so that at the end of five years the value of a car, even though it might be in excellent mechanical condition, is low. By this method, the owner of the automobile is brought to feel that after four or five years of use his car has little value, and he is easily persuaded to buy a new one. Adoption of this plan might entail the writing off in the first year of, say, one-third or one-fourth the investment cost of a boiler or engine. The second year the write-off would be less, so that at the end of ten years the undepreciated investment could be about ten per cent of the original. Management, then, would not feel that the discarding of an obsolete machine was entailing an actual capital loss.

Air Conditioning Is Increasing

THE United States—the northern half at least—is officially in the "temperate" zone. But if this means a climate nicely balanced between Arctic frigidities and equatorial heat, there must be some mistake. Temperatures above one hundred Fahrenheit have been recorded recently in some cities. Next winter the same places will probably be greeted by sub-zero blasts.

Without building heating much of the United States would be uninhabitable in winter. Summer heat can be endured, but the growing demand for comfort by the American people, and their growing financial and technical ability to obtain comforts as well as necessities, points clearly to an extended application of air conditioning in the near future.

Air conditioning is strictly an engineering problem, combining the fundamentals of heating, ventilation, and refrigeration. It is, moreover, a service involving the expenditure of substantial sums of money for equipment and energy. Logically, then, this field is to be of increasing concern to engineers, both as a specialty and as an important responsibility of power engineers in consulting and operating positions.

▼

POWER *Stands for . .*

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**
8. **Prevention of Smoke, Within Reason**

▼

New Power Plant at Lynn Adjoins Old Station

By J. A. COOK and J. T. CROGHAN
Lynn Gas & Electric Co. *Stone & Webster Engineering Corp.*

THE Lynn Gas & Electric Company, Lynn, Mass., recently completed a new power station to meet the rapid increase in demand for power and light in its territory. The new station is adjacent to an older plant, which will be operated in conjunction with the new one. Design and construction of the new boiler plant preceded by one year the installation of the turbine-generator and auxiliaries, because of an immediate demand for additional boiler capacity to serve the turbines in the older station.

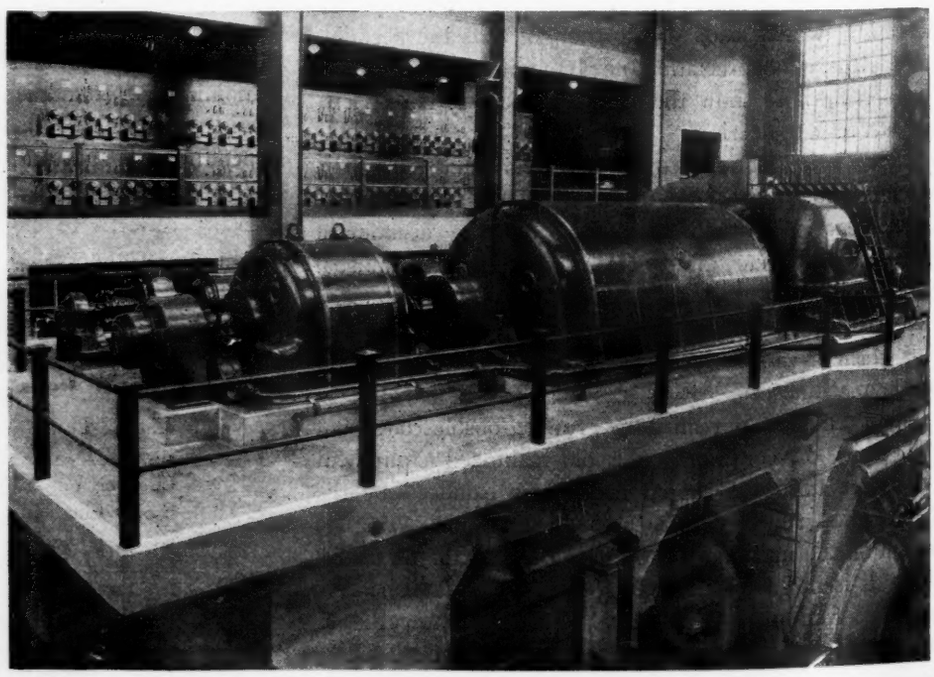
A study of the expected load indicated that the new boiler plant should be designed to serve a turbine unit of not less than 20,000-kw. capacity, and that the design should be such as to be adaptable to a 30,000-kw. machine if developments required that size. To meet this condition, two boilers of 1,500 sq.ft. each were installed and operated temporarily at a pressure and superheat suitable for the turbines in the older station. After the uncertain factors in regard to the expected load were cleared, a decision was reached to proceed with the installation of a 21,500-kw. turbine-generator. When this machine was ready to operate, the pressure and superheat were increased on the new boilers and a connection was made to the older turbines through reducing valves and a desuperheater.

The existing equipment for unloading and storing coal is utilized for both plants. The site of the station borders on Lynn Harbor, and an unlimited supply of condensing water is available. The two plants are connected by an administration building, which provides space for offices and shops to facilitate supervision and communication in the combined plants.

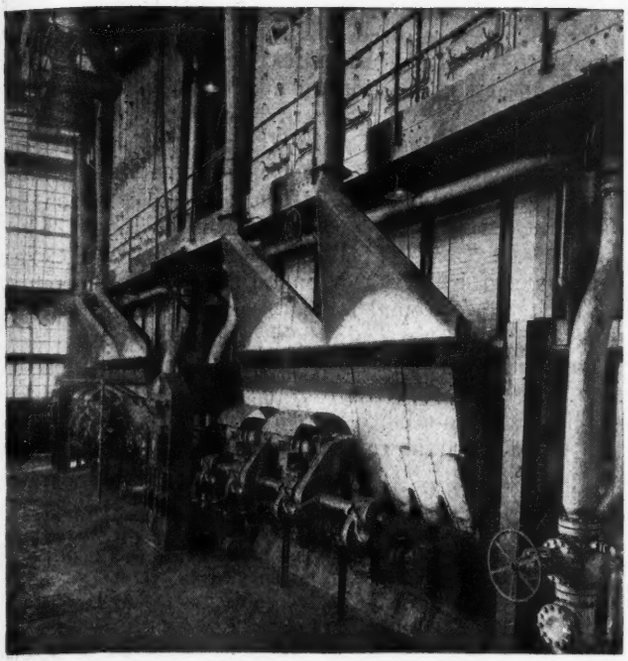
The building, which by a simple and effective architectural treatment presents a pleasing appearance, is a steel frame structure supported on piles and a superimposed concrete mat ,with brick walls and concrete floors and roof. Tile walls were used where extensions were contemplated.

The interior is divided into a boiler house 67 ft. wide x 97 ft. long x 98 ft. high providing space for two boilers, a turbine room parallel to the boiler room 57 ft. wide x 93 ft. long x 77 ft. high, an adjoining three-story electrical bay 38 ft. wide x 91 ft. long x 55 ft. high, and a three-story office bay 40 ft. wide x 56 ft. long x 37 ft. high. This office section adjoins and connects the old plant with one end of the turbine room.

The boiler plant comprises two 15,820 sq.ft. cross-drum water-tube boilers, each 33-sections wide with twenty 4-in. diameter, 20-ft. long tubes in each section. The boilers are designed for a working steam pressure of 450 lb. per square inch and are set singly. The superheaters are designed to deliver steam at a temperature



The main bleeder-type turbine drives a 25,000-kva. main generator, and 1,875-kva. auxiliary generator and exciter



▼ ▼ ▼

Steam generated at 450 lb. in the new plant is supplied to the old adjoining power house at 190-lb. pressure and to the gas works at 125-lb. pressure.

▼ ▼ ▼

of 710 deg. F. when the boiler is producing steam at the rate of 180,000 lb. per hour. The boilers are equipped with water-cooled furnace walls in the rear and side walls of the settings.

Two 11-retort, 41-tuyère underfeed stokers with double-roll clinker grinders are installed. The stokers are supplied with air preheated to a temperature of 350 deg. F., and have a projected grate area of 323 sq.ft. each. The stokers are driven by adjustable-speed brush-shifting motors, and the clinker grinders by two-speed squirrel-cage motors.

The boilers are served by a superimposed radial brick stack 12 ft. in diameter and 75 ft. high. Two motor-driven induced-draft fans, each of 110,000 cu.ft. per minute capacity, deliver the gases to the stack. Air required for combustion is supplied by four motor-driven forced-draft fans, each with a capacity of 31,000 cu.ft. per minute, two serving each boiler. These six fans are louver controlled. This design controls the pressure and volume by movement of vanes or louvers in the inlet of the fan, which permits of the use of constant or two-speed motors for drives. The air from the forced-draft fans passes through a tubular air heater with a heating surface of 12,100 sq.ft. The air ducts and flue connections are of the expansion-rib type.

The feed water systems provide for heating the condensate with steam extracted from the turbine at three points. The condensate is heated to about 155 deg. F. in a closed heater, passes to a deaërating heater, where it is heated to about 230 deg. F., and is then forced by feed pumps through a third heater, which raises the temperature to about 296 deg. F. The deaërator has a capacity of 400,000 lb. of water an hour, and a surge tank of 8,000-gal. capacity is provided.

The adjacent gas works of the company has a demand for steam at 125-lb. pressure, which at times amounts to 12,000 lb. per hour with but little return of condensate. To supply this steam, and also the feed water make-up, a two-effect evaporator, under normal operation, provides steam from the first effect to the gas works and delivers 12,000 lb. per hour make-up water to the deaërator in the new power station. A distilled-water storage of 20,000-gal. capacity is installed for reserve purposes.

One turbine-driven feed pump, of 900 gal. per minute capacity, and two motor-driven units, each of 450 gal. per minute capacity, serve the boilers. Distilled water is fed to the system by two motor-driven pumps each of 900 gal. per minute capacity, and a third turbine-driven pump is held in reserve.

Circulating water is taken from Lynn Harbor through a reinforced concrete tunnel 7 ft. x 7 ft. 3 in. in area, and is returned to the harbor by a similar tunnel at a point remote from the intake so as to avoid recirculation. A screen well fitted with two 8-ft. 11-in. x 30-ft. 6-in. traveling screens, driven by two 5-hp. motors, removes refuse and seaweed from the water. These screens are taxed to capacity in the fall season by schools of small herring which attempt to enter the tunnel system.

The condensers for the older turbines draw circulating water through cast-iron pipes, 30 in. in diameter, which formerly led to a near-by slip but are now connected to a suction well fed by the new tunnel.

The temperature of the water in Lynn Harbor does not reach 80 deg F. in the summer season, and the maximum amount of steam discharged to the condenser of the new turbine is estimated to be about 225,000 lb. per hour. To meet these conditions a surface condenser with 22,000 sq.ft. of effective cooling surface was selected and equipped with two motor-driven circulating-water pumps with a combined capacity of 28,000 gal. per minute when operating together. Each pump operating singly has a capacity of 20,000 gal. per minute, so that during a large part of the year one pump will suffice for the expected duty. Two motor-driven condensate pumps each have a maximum capacity of 250,000 lb. per hour, one being held in reserve normally.

The condenser is of the two-pass, two-compartment type, with Muntz metal tube sheets and Admiralty mixture tubes. The tubes, 1 in. in diameter, are rolled into the inlet tube sheet with entrance ferrules and are packed with corset lace in the outlet sheet. The condenser is supported on nests of springs to care for expansion. Air removal is effected by twin three-stage eductors with inter- and after-condensers, each with a capacity of about 15 cu.ft. per minute.

The piping systems present several features of in-

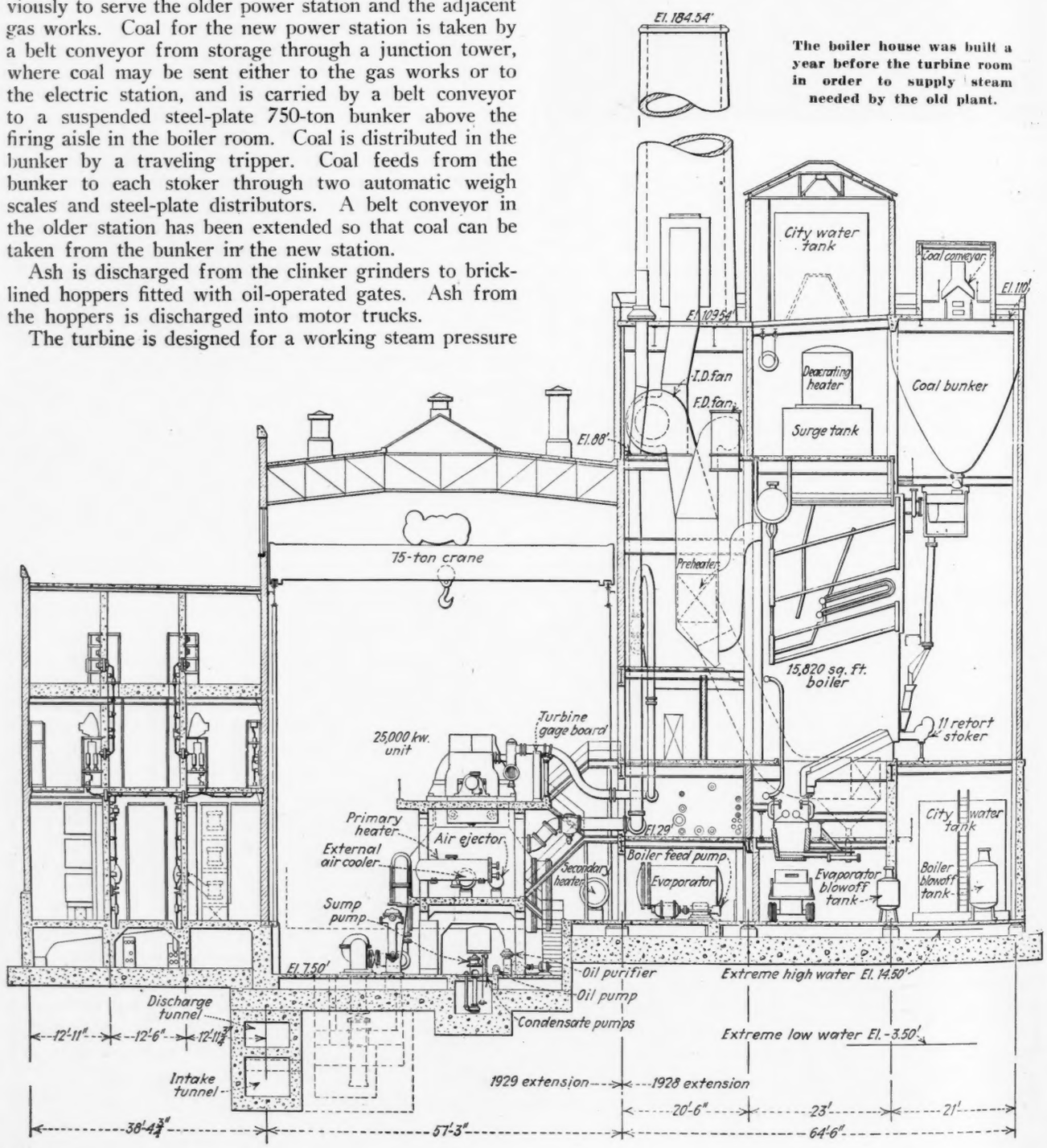
terest, such as the provision of Sargol-type flanges with welded seal in the high-pressure steam lines and the use of Nitralloy as a valve-seat material. Supply of steam to the older station at reduced pressure and temperature may reach 350,000 lb. per hour at times. Three 4-in reducing valves maintain a working pressure of 190 lb. per square inch at the header that serves the older turbines. The temperature of the steam is reduced from 710 deg. to 500 deg. F. by a desuperheater, with automatic regulation of the desuperheating water supply. The boilers in the older station are connected to the reduced-pressure header; therefore, adequate safety-valve capacity was required to protect against an increase of pressure in the event of the reducing valves' failing to function properly. Three high-capacity valves were installed for this purpose.

The equipment for handling and storing coal is designed to work in conjunction with that installed previously to serve the older power station and the adjacent gas works. Coal for the new power station is taken by a belt conveyor from storage through a junction tower, where coal may be sent either to the gas works or to the electric station, and is carried by a belt conveyor to a suspended steel-plate 750-ton bunker above the firing aisle in the boiler room. Coal is distributed in the bunker by a traveling tripper. Coal feeds from the bunker to each stoker through two automatic weigh scales and steel-plate distributors. A belt conveyor in the older station has been extended so that coal can be taken from the bunker in the new station.

Ash is discharged from the clinker grinders to brick-lined hoppers fitted with oil-operated gates. Ash from the hoppers is discharged into motor trucks.

The turbine is designed for a working steam pressure of 400 lb. per square inch with a total temperature of 710 deg. F. It is direct-connected to a main generator, wound to supply 3-phase, 60-cycle current at 13,800 volts, and also to a service or auxiliary generator, which supplies 3-phase, 60-cycle current at 550 volts. The main generator is rated at 25,000 kva. and the auxiliary generator at 1,875 kva. The auxiliary generator is fitted with a direct-connected shaft exciter. Excitation for the main generator is normally furnished by a 125-kw. dual-drive exciter, and a 200-kw. motor-driven exciter is provided for emergency operation of both generators. All exciters are wound for 250 volts and furnished with pilot exciters. No main field rheostats are installed. Voltage regulation is through individual regulators on each exciter.

The station auxiliaries are divided into two groups: (1) those essential to the continued operation of the



The boiler house was built a year before the turbine room in order to supply steam needed by the old plant.

Principal New Equipment Installed

Boiler House

Boilers, two 15,800-sq.ft. water-tube; interdeck superheater, Babcock & Wilcox Co.
Furnace water walls.....Fuller Lehigh Co.
Boiler setting .....George Allen & Son
Water-wall insulation .....Johns-Manville, Inc.
Air preheaters, two, 12,100 sq.ft.....Green Fuel Economizer Co.
Soot blowers, for boiler and air preheater, Diamond Power Specialty Corp.
Stokers, two, 11-retort, 41-tuyère; double-roll clinker grinder, American Engineering Co.
Combustion control .....Bailey Meter Co.
Forced-draft fans, four, 31,000 c.f.m.....B. F. Sturtevant Co.
Induced-draft fans, two, 110,000 c.f.m.....B. F. Sturtevant Co.
Ash hoppers and gates.....Allen-Sherman-Hoff Co.
Coal-conveying equipment .....John H. Proctor & Co.
Weigh scales, four 300-lb. automatic.....Richardson Scale Co.

Turbine and Condenser Room

Turbine, 21,500-kw., direct connected to 25,000-kva. main generator and 1,875-kva. auxiliary generator, General Electric Co.
Condenser, 22,000 sq.ft. .....Foster Wheeler Corp.
Vacuum pump, steam-jet, twin-element, three-stage, Foster Wheeler Corp.
Deaërating heater, 400,000 lb. per hr.....Elliott Co.
Stage feed-water heaters, two .....Elliott Co.
Evaporator, two-stage .....Griscom-Russell Co.
Oil purifiers .....De Laval Separator Co.

Pumps

Condenser circulating pumps, two, 24-in., motor-driven, Foster Wheeler Corp.
Condensate pumps, two, 4-in., two-stage, motor-driven, Foster Wheeler Corp.
Boiler-feed pumps, two, 450-g.p.m., motor-driven; one 900-g.p.m., turbine-driven .....Worthington Pump & Mach. Corp.
House-service pumps, two, 300-g.p.m., motor-driven, Worthington Pump & Mach. Corp.
Cooling water pumps, two, 1,000 g.p.m.....Dayton-Dowd Co.
Sump pumps, two, 2-unit.....Yeomans Bros. Co.

Valves

Cast-steel gate and check valves, Chapman Valve Manufacturing Co.
Forged-steel globe valves, Consolidated Ashcroft Hancock Co., Inc.
Low-pressure gate valves....Chapman Valve Manufacturing Co.
Cast-steel globe valves.....Lunkenheimer Co.
Boiler non-return valves.....Schutte & Koerting Co.
Boiler feed control valves, 4-in. diameter.....Stets Co.
Reducing valves .....Ruggles-Klingemann Manufacturing Co.
Boiler safety valves.....Ashton Valve Co.
Header safety valves.....Crosby Steam Gage & Valve Co.

Miscellaneous

Desuperheater .....Smoot Engineering Corp.
Coal spouts, four, non-segregating.....Rolland Lardner Co.
Crane, 75-ton, 15-ton auxiliary hoist..Northern Engineering Works
Heat insulation .....Keasbey & Mattison Co.
Piping, material and installations.....Lumsden & Van Stone Co.
Steam header, 16-in. diameter, hammer welded.M. W. Kellogg Co.
Steel plate work.....Connery & Co., Inc.
Water storage tanks, three, 20,000-gal., James Russell Boiler Works Co.

plant; (2) those on which short interruptions do not affect plant operation.

Classing these two groups as "major" and "minor" auxiliaries, the feed to them is supplied as follows: Major auxiliaries are normally furnished with power from the shaft auxiliary generator, which service is reinforced by a transformer bank fed from the main station buses. The transformer feed is normally open to the major buses, but on failure of the supply from the house generator, because of short circuit, field failure, or other trouble, the load is automatically transferred to the transformer bank. Interlocks are provided to prevent paralleling these two sources of power so that the auxiliary generator may not be tied in to the outside system.

The minor auxiliaries are at all times fed from the transformer bank, and are, therefore, subject to system interruptions. The transformer bank is designed to carry all necessary load with two units in open delta in case of the failure of any one unit. Truck-type switchgear with carbon circuit breakers, arranged in a double-deck structure, have all of the usual oil circuit breaker truck features. This arrangement of auxiliary switching requires half the space of the equivalent oil circuit breaker equipment and offers an economy in total installed cost. The motor controls are by push buttons at the motors, with all of the breakers electrically operated. All motors are designed to be thrown directly across line without auxiliary starting equipment.

The output of the station is distributed both at 13.8 kv. and at 4 kv. through the old generating station, the two stations being interconnected by 30,000-kva. bus tie transformers in two banks. Electrical control of the generating unit and all feeder switching is through a miniature desk board in the control room of the older station, which permits of a reduction in operating personnel and facilitates the operation of the two stations as a unit.

A four-motor traveling crane, of 75 tons' capacity, handles equipment in the turbine room. The fan room is equipped with a special traveling hoist for quick handling of fan rotors or motors.

Air coolers for the main and auxiliary generators use sea water, and CO_2 fire-extinguishing equipment serves the generators. An oil filtration system is provided for purification of lubricating oil.

The power station has a complete equipment of indicating and recording instruments to aid the economical operation of the plant. Preliminary operation of the equipment indicates the expected economy has been realized.

The power plant was designed and constructed by Stone & Webster Engineering Corporation in co-operation with the staff of the Lynn Gas & Electric Company.

Tests on German Turbine Generator Reveal High Efficiency

REPORTED tests of an 85,000-kw. two-cylinder tandem-compound turbine-generator installed in the Zschornewitz power plant of the Elektrowerk A.-G., Berlin, indicate that unusually high efficiencies were obtained. The turbine was designed for two-stage extraction, but the tests were carried out without extraction. The test data indicate a turbine efficiency of 87.7 per cent. A generator efficiency of 97.1 gives over-all unit efficiency of 85 per cent. The steam conditions given in the tabulation were measured ahead of the main stop valve.

	Acceptance Test
Steam pressure, lb. per sq. in. abs	202
Steam temperature, deg. F	698.5
Cooling water temperature, deg. F	95.5
Output, kw	83,730
Steam consumption, lb. per kw.-hr	10.28
Alternator efficiency, per cent	97.1
Efficiency of turbine at coupling, per cent	87.7

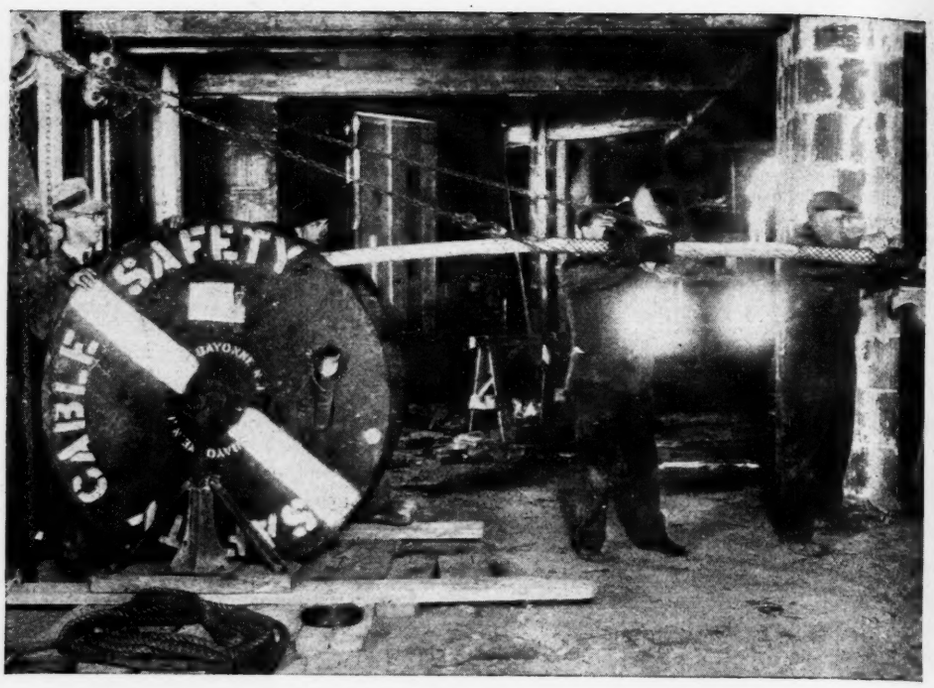


Fig. 1—Two basket come-alongs and 1-ton chain falls controlled the cable as it was lowered into the conduit

High-Voltage Feeders *LOWERED into* Vertical Conduit

By H. S. ARNOLD
Supervising Engineer
Chrysler Building, New York City

In the world's tallest building feeders 350 ft. long weighing one ton were lowered into vertical conduit. The feeders are supported from the top end only, hanging free in the conduit

IN THE Chrysler Building, New York City, a 13,800-volt feeder system is carried from the street to the 74th floor. From a central splicing chamber in the sub-basement the feeders run in seven 3½-in. vertical conduits to the 30th floor. There they terminate in a splicing chamber and a transformer vault. Five high-voltage cables run from the 30th floor splicing chamber to the 60th floor, where they enter another splicing chamber. A third run of three cables goes from the 60th to the 74th floor.

Each cable consists of three No. 0 conductors insulated with rubber for 15,000 volts, with a tinned-copper tape over the rubber. The three conductors forming each cable are assembled with a jute filler. A No. 10 steel-wire armor covers the jute. The cables weigh about 6 lb. per foot. As the runs from the sub-basement to the 30th floor are 350 ft. long, each cable weighs about one ton.

Installation presented a problem, handling vertical cables weighing 2,000 lb. is no simple matter and no experience information was available for conductors of such weight. Supporting the cable in the conduit also presented another problem, to which careful study was given. At first it was suggested to break the conduit at every second floor and install a heavy cast-iron box with a cover. It was proposed to place a cable support and clamps in each box, but it was decided that the expense would be prohibitive. A request was made to the utility company's engineers for a modification of the contemplated plan that would reduce installation costs. They developed a method of supporting the cables at the top end only, and it was finally adopted. The sup-

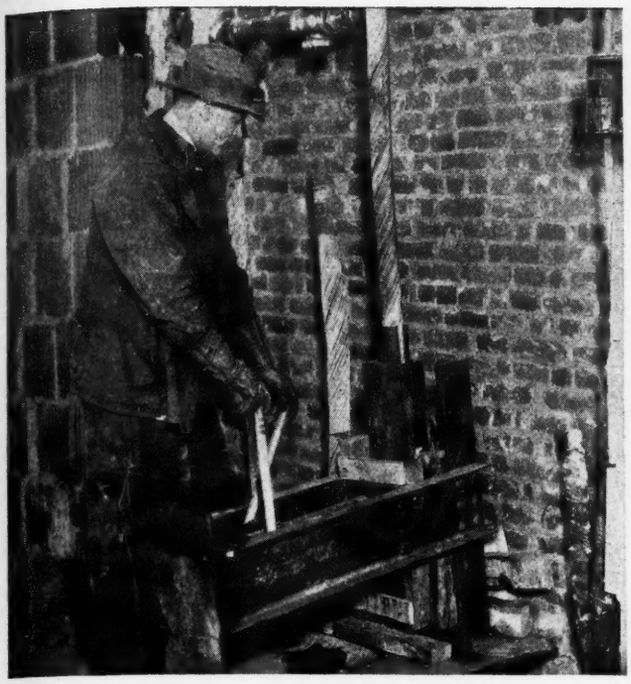


Fig. 2—A hydraulic pipe bender with special shoes was used as a brake to hold the cable

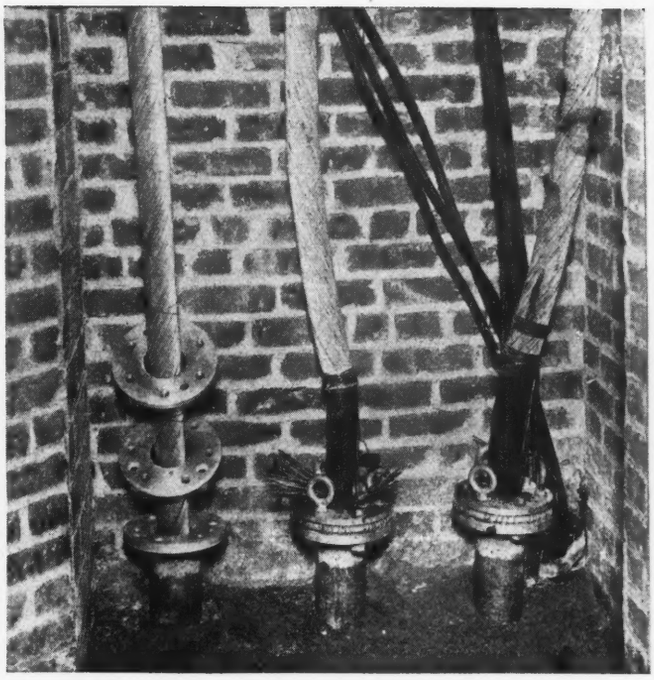


Fig. 3—Clamps being placed on the top end of the cables to support them in the conduits

port installed consists of a clamp attached to the cable armor and resting on the top end of the conduit. A cross-section of the clamp is shown in Fig. 5. This clamp is made in three sections, or plates, each 8 in. in diameter and from $\frac{1}{2}$ to $\frac{3}{4}$ in. thick. The lower plate has six threaded holes for $\frac{5}{8}$-in. bolts. Three of the bolts are made with an eye on the top for hooks, in the event it is ever necessary to lift the cable.

The superintendent for the electrical contractors, Hatzel & Buehler, solved the problem of lowering the cables into the conduit by rigging the reels on the floor above the splicing chamber and running the cables over a sheave, the sheave being an empty reel with the lagging in place. Two open-basket come-alongs were placed on the cable being installed, and it was retarded by two 1-ton chain blocks fastened to steel beams of the building, Fig. 1. To permit of shifting the come-alongs on the cable a hydraulic pipe-bending machine, of the cylindrical type, for use in a vertical position, was employed as a brake. It was placed in a horizontal position and the cable was gripped between two shoes made by splitting a section of $2\frac{1}{2}$-in. conduit. When it became necessary to shift the come-alongs, pressure was applied to the shoes against the cable and it thus was held until the position of the baskets were changed to allow for another drop of approximately 20 feet.

When the lower end of the cable reached the splicing chamber a serving of wire was put around the armor, and the clamp was brought down to the top of the vertical conduit. The No. 10 galvanized-steel-wire armor was cut out and the proper length unraveled from the outside of the cable and laid out flat on top of the first section of the clamp. The second section of the clamp was then set in place and the steel armor wires were turned over on the rounded edge and placed in such a position that the third section of the clamp could be brought down into place and the set-screws tightened. When no additional tension could be obtained by set-screws, the armor was cut off close to the cable and bent down flat on top of the third section.

The cables have been in service for approximately seven months without showing any creeping or slipping of the armor in the clamps or of the cores. In other words, the clamps are holding the cables in the same position now that they did when they were installed.

Fig. 4 shows the construction of the shoes for the hydraulic pipe bender used as a brake when the cables were being lowered into the conduit. The shoes that came in contact with the cable consisted of a piece of $2\frac{1}{2}$-in. conduit, 32 in. long, split in two halves. The top end was belled to eliminate danger of injury to the armor or the cables. The pieces of conduit were spot welded into a 4-in. channel iron 24 in. long, which, in turn, were spot welded into 6-in. channel irons 24 in. long. The channel irons acted as a mounting for the conduit sections and as stiffeners for the shoe.

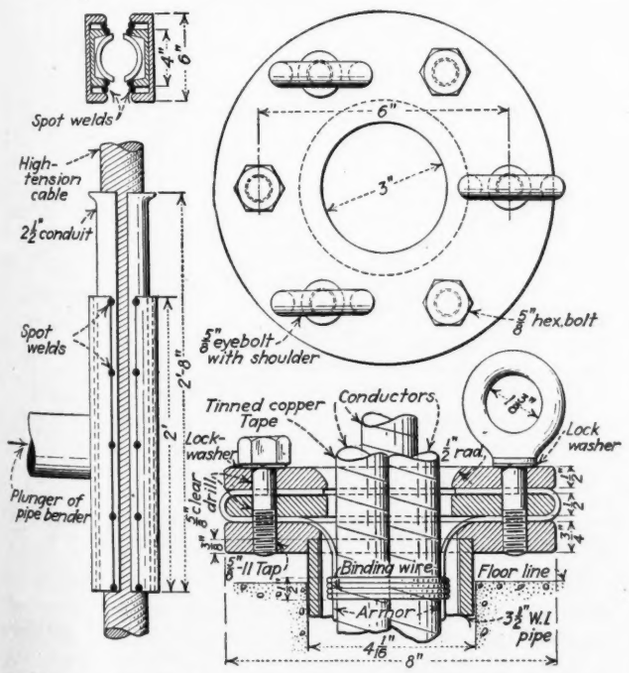


Fig. 4 (Left) Brake shoes used in the pipe bender. Fig. 5 (Right) Section through clamp placed on the top end of the cables

Application of Turbines to Power Generation

By A. G. CHRISTIE
Johns Hopkins University, Baltimore, Md.

Selection of steam turbines for power generation is influenced by rate of power load growth, low first cost, low maintenance, savings in operating labor, high thermal efficiency, high reliability and availability factors, and concentration of power on small floor area. These factors are discussed in this abstract of Professor Christie's paper presented at the recent World Power Conference.

SEVERAL FACTORS influence the choice of capacity in a new turbine. Rate of load growth of a given system at times indicates that certain sizes of units should be installed as required by the increasing demand. Too small units would, in many cases, necessitate too frequent plant additions. Too large a unit may require operation at low use factors when first installed.

Duplicate units in a station are sometimes preferred. The advantages of this arrangement are interchangeability of parts in event of trouble, and small investment in spare parts. As the operating reliability of turbines increases, these advantages become of less value. Since additions to a plant are generally made over a period of years, the first of such duplicate turbines added generally lack the improvements in design that have developed since the station was planned. Thus units of the current design at the time of each extension and often of progressively increasing size and efficiency are usually installed.

The capacity of a new unit should be such that in case of outage the remaining units of the system can safely carry the load. Recent practice indicates that the size of new units varies between one-sixth and one-fourth of the system's total capacity.

New turbines are sometimes added to power systems to carry base loads. The economics of such an addition to a growing system may sometimes be questioned, for in practice the base load is transferred, in turn, to the newest and more economical machine. The use factor of an original unit which may have been intended for base load thus becomes progressively less and less with each addition to the system. Turbines are now generally selected on the basis of the average annual use factor over their working life rather than on high use factors that may only be obtained during the first years of service.

Data on modern turbines that will assist in their economic selection are presented in Figs. 1, 2 and 3. These curves indicate the savings that may be expected in floor space, and operating and first costs through the use of large units.

The advisability of large units in power systems of moderate size may be questionable when due consideration is given to reserve. A single large unit may be so expensive that adequate reserve to replace its outage is not provided. This leads to operating difficulties when an outage would cripple the service of the system. In such a case a smaller sized unit with adequate reserve would be preferable.

The size of necessary reserve cannot be determined by any fixed rules. Enough capacity in the same or in other interconnected stations should be held in reserve to carry the load in case of outage of the largest unit. This reserve margin is sometimes sacrificed to a considerable extent at the time of maximum annual peaks where these are sharp and of short duration.

The choice of most economical steam pressure and temperature for a new turbine plant presents a difficult problem of the highest importance. The question is whether the savings in fuel resulting from the employment of higher steam pressures and temperatures are sufficient to offset the increased fixed charges on high-pressure equipment.

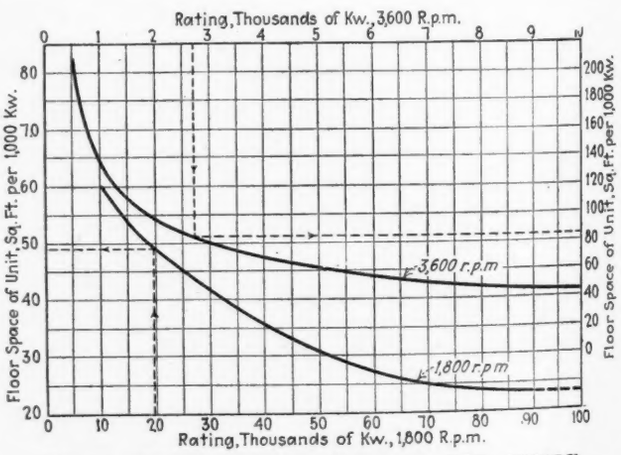

Rating, Thousands of Kw., 3,600 R.p.m.
Floor Space of Unit, Sq. Ft. per 1,000 Kw.
Floor Space of Unit, Sq. Ft. per 1,000 Kw.
3,600 r.p.m
1,800 r.p.m
Rating, Thousands of Kw., 1,800 R.p.m.

FIG. 1—FLOOR SPACE REQUIRED FOR SINGLE-CYLINDER TURBINE-GENERATORS

Area consists of a rectangle enclosing turbine, generator and direct-connected excitor with an added rectangle for any offset valve gear.

Opinions have been at variance regarding the cost of plants using pressures of 1,200 lb. per square inch and

above. The first installations with these high pressures were expensive because all equipment carried high development charges. Standardization of parts and improvements in design have substantially reduced the cost of high-pressure equipment. The lowered heat consumption, through the use of high initial steam pressure and temperature with reheating, has lessened the size of boilers, furnaces, coal-burning equipment, condensers, and condenser auxiliaries, so that the total cost of a plant for 1,200 to 1,500 lb. per square inch pressure at the present time is said not to exceed that of a 450-lb. plant by more than 5 per cent. This difference will continue to decrease, and 1,500-lb. plants will eventually cost no more, or at most very little more, than one at the lower pressure.

Tests indicate that in large turbine units the high-pressure section receiving steam at 1,200 lb. per square inch can be designed to give nearly as high engine efficiency as its low-pressure section, and that compound units can be built to give over-all engine efficiencies of 78 per cent based on kilowatt output.

Initial steam temperatures have not in general exceeded 750 deg. F. With this temperature limit, increases in initial steam pressure above 450 lb. per square inch with modern high-efficiency turbines results in excessive quantities of moisture at the last blades of the turbine. Rapid erosion of metal takes place, and the efficiency of the unit, initially decreased by the presence of the moisture, is further lessened by the eroded blading. Engineers are therefore limiting the moisture content of exhaust steam to 10 per cent to lessen these troubles.

The rapid decrease in tensile strength of ordinary steels at temperatures above 750 deg. F., together with

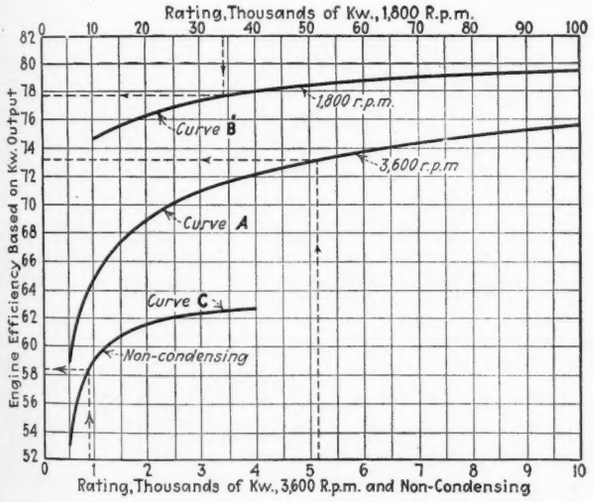


FIG. 2—AVERAGE ENGINE EFFICIENCY FOR THE LOAD POINT OF BEST EFFICIENCY BASED ON KILOWATT OUTPUT AT THE GENERATOR TERMINALS

Curve *A*, for steam conditions up to 300 lb., 600 deg. Curve *B*, for steam conditions up to 450 lb. and 750 deg. Curve *C*, for steam conditions up to 250 lb. and 550 deg.

troubles from "creep," have made engineers question the use of such steels at these higher temperatures. Recent experiences with certain alloy steels now warrant their safe use at high temperatures. It is proposed to allow such stresses in the design of turbines for high temperature, that "creep" will not exceed one one-hundredth of 1 per cent per year.

Increased steam temperature tends to increase the cost of superheaters, main steam piping, and the high-pressure section of the turbine. This increase is a small portion of the total plant cost, and is partly offset by the savings in the required boiler capacity. Total increase in cost, even if special alloys are used, should be less than the cost of reheaters. It would appear that increased plant economy may be obtained by increased temperatures, together with high pressures, at a lower total cost than by the employment of reheaters, and also that the use of higher superheat will lead to a simpler station.

In general, estimates and actual performances have shown a gain due to reheating for initial steam pressures at 600 lb. and higher of 6 per cent to 8 per cent. It has been stated that a large part of this gain has resulted from the improvement of turbine efficiency in the low-pressure stages.

There has been, however, no general statement made covering an analysis of the heat added during the reheat

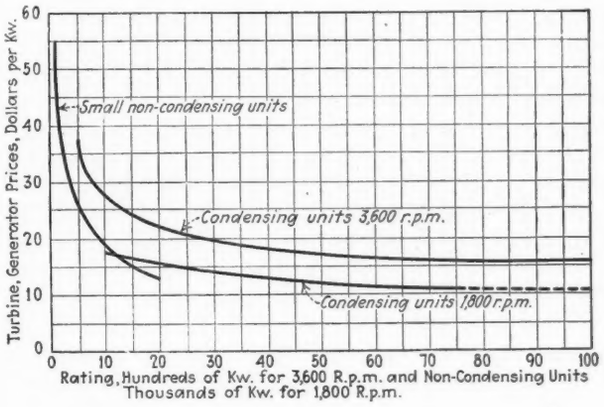

Turbine, Generator Prices, Dollars per Kw.
Small non-condensing units
Condensing units 3,600 r.p.m.
Condensing units 1,800 r.p.m.
Rating, Hundreds of Kw. for 3,600 R.p.m. and Non-Condensing Units
Thousands of Kw. for 1,800 R.p.m.

FIG. 3—PRICE FOR TURBINE-GENERATOR UNITS IN THE UNITED STATES

Prices do not include auxiliary generators or direct-connected exciters and are for units delivered and erected. They are for pressures up to 400 lb. and 725 deg. steam temperatures.

operation. In a reheat cycle the steam, after being partly expanded, is withdrawn and has heat added to it, after which it is returned to the unit and the expansion continued to exhaust pressure. If the additional energy rendered available by the reheating process is divided by the heat added to the steam in the reheater the quotient expresses the efficiency at which the reheater is rendered available. Also, if the additional work done by a turbine as a result of reheating is divided by the heat added in the reheater the quotient expresses the efficiency at which reheat is used.

Figs. 4 and 5 summarize the results of calculations on the efficiency at which reheat is used with absolute steam pressures of 2,000 lb. and 1,200 lb. per square inch, with 800 deg. temperature, and 29 in. vacuum, for different reheat pressures, with reheating in every case to the original temperature of 800 deg. F. and for engine efficiencies at the coupling of 100 and 80 per cent, but with no regenerative bleeding. To simplify the problem, no allowance was made for moisture or for pressure drop through reheaters. Computations were made for a non-reheat and a reheat turbine operating with exactly the same over-all efficiency for each expansion, in order to demonstrate the fundamental reheat efficiency and the actual gain in cycle efficiency irrespective of the influence of changes in moisture content on the efficiency of low-pressure turbine stages. The upper curves of Figs. 4 and 5, indicating the efficiency at which reheat is used, show increasing efficiency with the higher reheat pres-

sure ratios. If allowance had been made for moisture in the low-pressure sections, the efficiency at which reheat is used at 80 per cent engine efficiency would have been increased over the values in the curves.

The increase in thermal efficiency by the use of reheat seems to be due largely to the fact that the heat added by the reheater is utilized at a greater efficiency than that added by the boiler. At high reheat pressure ratios, the efficiency of the use of reheat is high, but the reheat added by the reheater is small, and at low reheat pressures the reverse is true. Inasmuch as the thermal efficiency of a reheat cycle is a combination of the amount of reheat and the efficiency of its utilization, there will be a certain reheat pressure, for given operating conditions, which shows highest thermal efficiency. Such reheat pressures are indicated by the points of maximum thermal efficiency on the curves. These maximum thermal efficiencies with extracting and reheating occur with reheat pressure ratios of 30 per cent of the initial pressure at 80 per cent engine efficiency, which is somewhat higher than current practice of 20 per cent to 25 per cent.

A study of Figs. 4 and 5 indicates that the efficiency at which the reheat is used is substantially constant at the various reheat pressure ratios with 80 per cent engine efficiency. Calculations show that the B.t.u. gain in available heat at 80 per cent engine efficiency and with reheat to 800 deg. F. at all usual reheat ratios increases with the higher pressures. Hence the total gain in work from the reheat must also increase with the higher pressures. This is shown by the thermal efficiency curves with extracting and reheating, where the thermal efficiencies at a reheat pressure ratio of 30 per cent increase from 37.5 per cent at 1,200 lb. abs. and to 39 per cent at 2,000 lb. per square inch absolute. This suggests that the decrease in heat consumption with 2,000 lb. may justify the use of that pressure in place of 1,200 lb., as in present practice.

Little attention is paid to engine efficiencies alone in selecting turbines for a given service, since these efficiencies are generally highest at only moderate vacuum. Engineers demand units that will give the best performance in B.t.u. per kilowatt-hour. This leads to particular care in the recovery of all waste heat through the use of generator air coolers, oil coolers, and inter- and after-condensers on steam jet air pumps, and to the most economical arrangement of bleeders and evaporators. Condensers and condenser pumps are designed to secure maximum vacuum with the temperature of the water at hand.

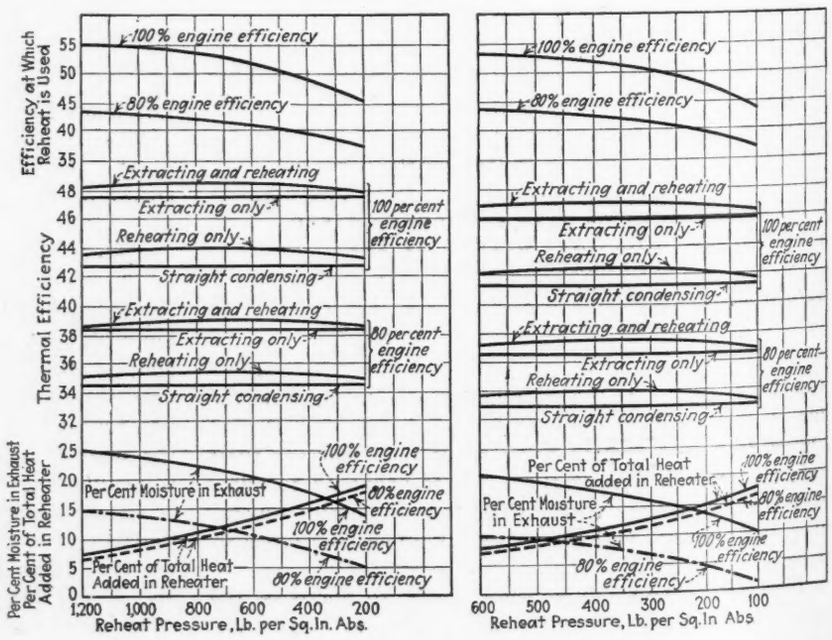
Attention has already been called to the low average use factors that prevail throughout the economic life of a turbine. These are not always given due weight, and higher efficiencies are sometimes demanded in turbines than are warranted by local operating conditions. Assume that two turbines of the same size are required for two plants, one with high use factor and high fuel cost; the other a stand-by to a hydro-electric plant with low use factor and cheap fuel. In the first case a design for highest economy is needed for which a high price can be paid; in the second a cheap unit of indifferent efficiency will serve most economically. The price of "made-to-order" units for each such service would be unduly high. Manufacturers have developed certain standard sizes of casings, and these may be utilized to suit almost every demand at reasonable cost and efficiency.

A turbine casing can be given a number of ratings and can be provided with generators of varying capacity while keeping the annular area of the last row of blades constant, by changing the leaving velocity from the last row, and by adjusting the dimensions of the high-pressure blading to the quantity of steam flowing at the given rating. This casing can have low ratings with low leaving losses for operation with high use factors and high fuel costs, and high ratings with high leaving losses when use factors are low and fuel is cheap. The cost of a turbine for a given speed varies, in general, with the area of the last row of blades, for the high-pressure blading can usually be modified as desired with little change in total cost. Furthermore, when the casing is given high ratings the increased steam flow through the high-pressure blading results in longer blades with a lower per centage of leak, and, hence, in high efficiency. This gain partly offsets the increased leaving losses at this high rating. Hence a low-use-factor turbine can be manufactured at low cost per kilowatt by increasing the rated output of a given casing.

The area of the annulus of the last row of blades per 1,000 kw., and the leaving losses therefrom, have varied during the past few years. In the early days of turbine construction units were small and an ample blade annulus could be provided at little increased cost, but velocities in these areas became high as capacity of casings increased. Increased capacities and the construction of turbines with maximum rating well above the most efficient load have resulted in progressively decreasing annular area per 1,000 kw. of capacity at rating, and in higher leaving velocities. The single annulus of low-pressure blades at 1,800 r.p.m. has increased to over 80 sq.ft. At pres-

FIGS. 4 (LEFT) AND 5 (RIGHT)—ANALYSES OF REHEATING

Fig. 4: Initial conditions of 2,000 lb. abs. and 800 deg. and reheating at various pressures to 800 deg. Fig. 5: Initial conditions 1,200 lb. abs. and 800 deg. and reheating at various pressures to 800 deg.


Efficiency at Which Reheat is Used
Thermal Efficiency
100% engine efficiency
80% engine efficiency
Extracting and reheating
Extracting only
Reheating only
Straight condensing
100 per cent engine efficiency
80 per cent engine efficiency
Per Cent Moisture in Exhaust
Per Cent of Total Heat Added in Reheater
Per Cent Moisture in Exhaust Per Cent of Total Heat Added in Reheater
Reheat Pressure, Lb. per Sq. In. Abs.

ent the annulus of the last blade row varies from about 1.25 to 2.5 sq.ft. per 1,000 kw. of turbine rating. The average values of the leaving losses vary from 1.5 per cent to 5 per cent of the total adiabatic heat drop from initial steam conditions to vacuum.

An Analysis of Rating for a Turbine Casing

An analysis of the relations of use factor, turbine cost, operating cost, and leaving losses, to the economic rating of a given turbine casing is shown in Figs. 6 and 7. The turbine casing assumed is normally rated at 30,000 kw., 1,800 r.p.m., with 300 lb. per sqare inch gage, 620 deg. F. steam exhausting to 29 in. vacuum, and with 57 sq.ft. of last blade annulus. Its most efficient load at that

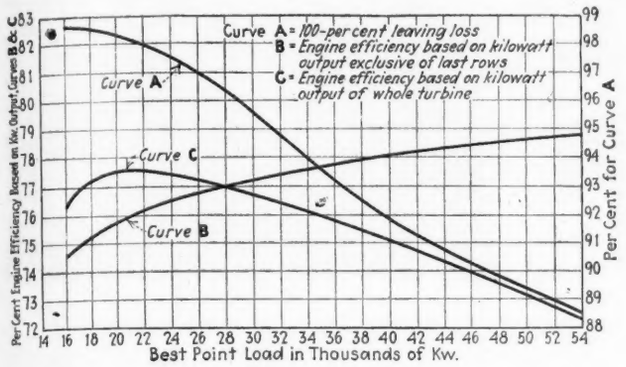

Curve A = 100-per cent leaving loss
B = Engine efficiency based on kilowatt output exclusive of last rows
C = Engine efficiency based on kilowatt output of whole turbine
Curve A
Curve C
Curve B
Per Cent Engine Efficiency Based on Kw. Output, Curves B & C
Per Cent for Curve A
Best Point Load in Thousands of Kw.

FIG. 6—PERFORMANCE AT VARIOUS RATINGS

Of an 1,800-r.p.m. reaction turbine-generator with 57 sq.ft. of last-blade annulus with high-pressure blade area proportioned to steam flow. Operating conditions, 300 lb., 620 deg. and 29 in. vacuum.

rating and 100 per cent use factor is at 75 per cent of rated capacity, or 22,500 kw. It was assumed that the high-pressure blade areas could be varied to suit the particular rating desired. Curve *A*, Fig. 6, indicates 100 per cent less leaving losses in per cent of total available heat drop under the stated steam conditions at the best point of efficiency for each rating. These leaving losses increase from 1.35 per cent at a best-point rating of 16,000 kw. to 11.4 per cent at a best-point rating of 54,000 kw. Curve *B* indicates the rate of increase of engine efficiency of the whole turbine, except the low-pressure blades, which results from the lower leakage losses and greater steam volumes with the increased flow at higher ratings. Curve *C*, a combination of Curves *A* and *B*, is the engine efficiency of the whole turbine based on kilowatt output for the point of best efficiency at the various ratings, and shows the effect on efficiency of increasing the ratings of such a turbine.

Curve *E* in Fig. 7 shows the annual fixed charges per kilowatt at 17 per cent of the cost of the turbine-generator installed with foundations and piping. Unit cost in this analysis varied from $17.20 per kilowatt for a 30,000-kw. maximum continuous-rated turbine-generator to $13.20 per kilowatt for the turbine-generator increased to 50,000 kw. maximum continuous rating. Curves *F* are annual operating costs per kilowatt of capacity for a variety of steam costs in dollars per 1,000 lb., and of use factors expressed as a decimal the product of which is indicated by the quantity *K*. Thus $K = 0.20$ may indicate steam at $0.20 per 1,000 lb. and a use factor of 100 per cent, or steam at $0.40 per 1,000 lb. and a use factor of 50 per cent. In calculating curve *F* the steam consumption at each best-point load based on the efficiencies shown by curve *C*, Fig. 7, has been increased 2.5 per cent to allow for load fluctuations. These *F* curves cover variations in use factors from 12.5 to 100 per cent, and in steam costs from $0.20 to $0.40 per 1,000 pounds.

Curves *G* show the total cost per kilowatt-year, which is the sum of the operating costs as shown by curves *F*, and the fixed charges as shown by curve *E* for various values of *K*. The curves *G* indicate that, as *K* decreases, the point of highest commercial economy as measured by lowest total cost per kilowatt-year at the best-point rating moves progressively to higher turbine capacities, as shown by the intersection of line *M* with the *G* curves. A stand-by turbine with very low use factor and low fuel cost, resulting in a still lower value of *K* than shown in the curves, would have its point of lowest annual cost at still higher capacities than in these

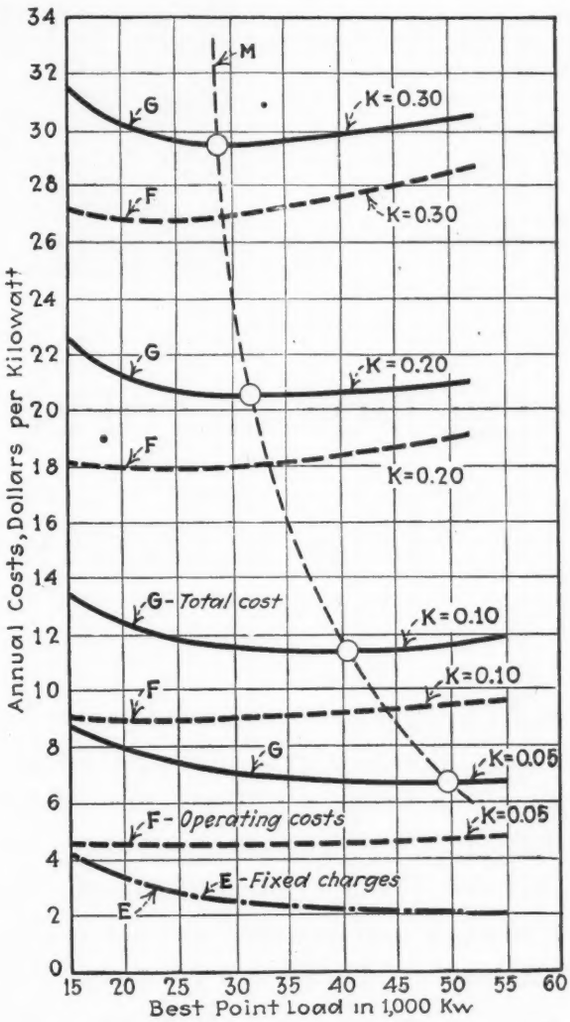
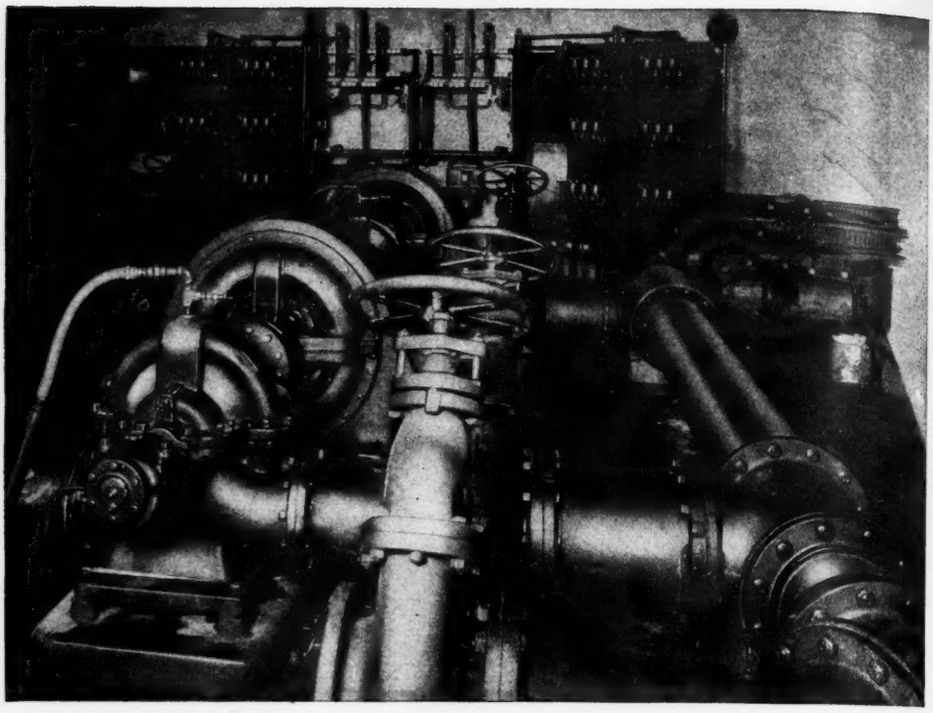


FIG. 7—FIXED CHARGES, ANNUAL OPERATING COSTS AND TOTAL ANNUAL COSTS

For turbine-generator of Fig. 6.

curves. The upper curve *G*, for high fuel costs and high use factors, shows that under the premises assumed no material increase over standard rating can be made economically. The lowest curve *G*, where fuel costs and use factors are low, indicates that the best-point rating to give lowest total annual cost may be some 65 per cent above usual practice.

A manufacturer, when furnished with specific operating data by the purchaser, can determine by such an analysis the rating of a casing that will give the lowest annual cost under given conditions. A similar study of other sizes of casing will show which casing and rating will serve the customer's needs at lowest total yearly cost.



Two high-head, high-efficiency, single-stage, double-inlet centrifugal pumps

SELECTION *and* OPERATION *of* Mine Pumping Plants—II*

Should plunger or centrifugal pumps be used; thirteen-stage centrifugal pumps operating under a 1,700-ft. head; how difficulties with long water columns were overcome; pumps operating in series on high-head applications and preventing overloading of motors driving centrifugal pumps—these are among the practical problems considered

BY L. D. ANDERSON

Chief Engineer
U. S. Smelting, Refining and Mining Company
Salt Lake City, Utah

THE QUESTION of whether to use reciprocating or centrifugal pumps often arises. Reciprocating pumps of good design have in the past generally surpassed centrifugal pumps in efficiency. Where the water is very muddy or gritty a plunger pump will handle it more readily and with less wear than a centrifugal. On the other hand, present tendency is toward high-speed rotating types in preference to slow-speed reciprocating units. Small weight per unit of capacity is perhaps the biggest advantage in favor of centrifugal pumps. The pumps cost less, handling is less expensive, smaller pump rooms minimize excavation costs, and the pumps may be directly connected to efficient high-speed motors. For these reasons centrifugal pumps are used extensively in mining operations.

A settling reservoir can often be employed to remove sand from the water where centrifugal pumps are used and in this way prevent excessive wear on the pumps. Fig. 1 shows an installation of two pumps, each capable of raising 500 gal. per minute against a total head of 1,700 ft. The settling sump made it possible to use high-efficiency centrifugal pumps with success.

The high lift and relatively small capacity in this case made it difficult to obtain high efficiency. A 72 per cent efficiency, guaranteed by the builders, was obtained by using thirteen stages arranged so that one unit of five stages, coupled to one end of the shaft of a 400-hp. motor, delivered in series to another unit of eight stages on the other end of the motor shaft, as shown in the figure.

One of the problems encountered in this installation was that of maintaining the pump column in line. As originally installed it was side braced to the shaft tim-

*For Part 1 see *Power*, July 29, 1930.

bers. After the pumps had been running for a short time it was discovered that the column was being distorted and was breaking away from the timbers. A number of bends about 200 ft. long, each with a maximum deflection of 34 in. from the vertical, were found in the lower half of the column. Conditions were decidedly alarming, and it was necessary to take quick action to save the installation.

Two devices were adopted to correct the trouble. One of these was to use clamps, Fig. 2, anchored in drill holes in the rock. These also served to draw the column into position and anchor it there. Spring suspensions, Fig. 3, were used to take part of the column's weight off the pipe. This equipment had to be devised and made up in a hurry, as there was danger that the pipe might collapse. With the supports installed no further trouble was experienced with this pipe. This experience emphasizes the necessity of securely anchoring long pipe columns in mine shafts.

Centrifugal pumps will sometimes develop peculiar tendencies that may be puzzling if one is not familiar with their performance characteristics. The addition of a second pump of the exact size and design of the first does not necessarily mean doubling the capacity, for the greater flow of water increases the friction head and thereby decreases the pumps' capacities. Sometimes when running with a throttled discharge a pump may deliver at one time only a fraction of the amount it will at another time with exactly the same throttle opening. This results from a convex head-capacity characteristic curve on which there are two points of exactly the same head but of widely differing capacities. [For a discussion of these interesting points the reader is referred to the article by M. J. Reed, *Power*, p. 788, May 14, 1929.]

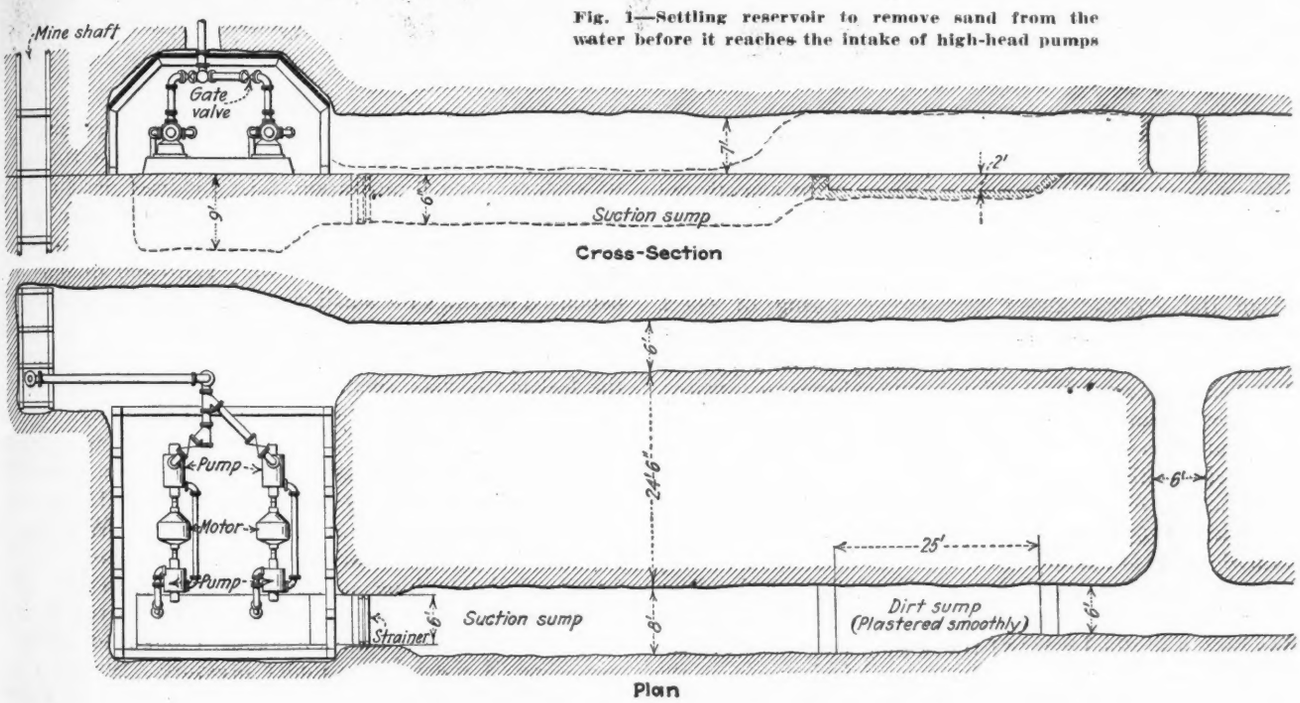
A notable development of recent years is the single-stage double-suction volute pump, which has shown sustained efficiencies of 80 to 90 per cent. The simplicity and high efficiency of this pump make it particularly desirable for mine pumping service. The maximum head for which this pump is practicable appears, at present, to be in the neighborhood of 300 ft. One pump manufacturer has recently put on the market a multi-stage design for higher heads that consists of the requisite number of stages for any head incorporated into a single body, each stage having the general characteristics of the single-stage, double-inlet volute design. It would appear that this arrangement should give high efficiency for high heads. But at any rate, the single-stage type has proved thoroughly dependable and efficient in practice.

In a recent paper before the Utah Chapter of the A.I.M.M.E., Leonard Wilson, consulting engineer, Salt Lake City, suggested an arrangement of pumps of this type for deep-mine service that embraces a number of single-stage pumps at 300-ft. levels, one above the other. For example, with a total head of 1,200 ft. divided into four 300-ft. stages, the stations should be at the 1,200-, 700-, and 400-ft. levels, so that each pump would receive its water at a positive head of 100 ft. and discharge it at a head of 400 ft. This method contemplates the elimination of sumps on the upper levels, the pumps being piped together in series.

This arrangement eliminates any instability due to one pump's taking the water away too fast. Flow can be regulated by throttling or by speed adjustment at any station. Each station would deliver its flow under pressure to the next so as to avoid negative suction pressures. The plan does away with the extra-heavy hydraulic pipe and fittings required for a single high lift. Certain details require careful planning. The check valves must be of the right type, air relief valves are necessary at every point where air pockets can form, and water pressure relief valves must bypass each check valve to prevent static pressure's building up when the pumps are not running. With such precautions the arrangement proposed appears to offer attractive possibilities.

Without entering into all the details of pump column installations, which of necessity must be worked out for each particular installation, mention should be made of

Fig. 1—Settling reservoir to remove sand from the water before it reaches the intake of high-head pumps



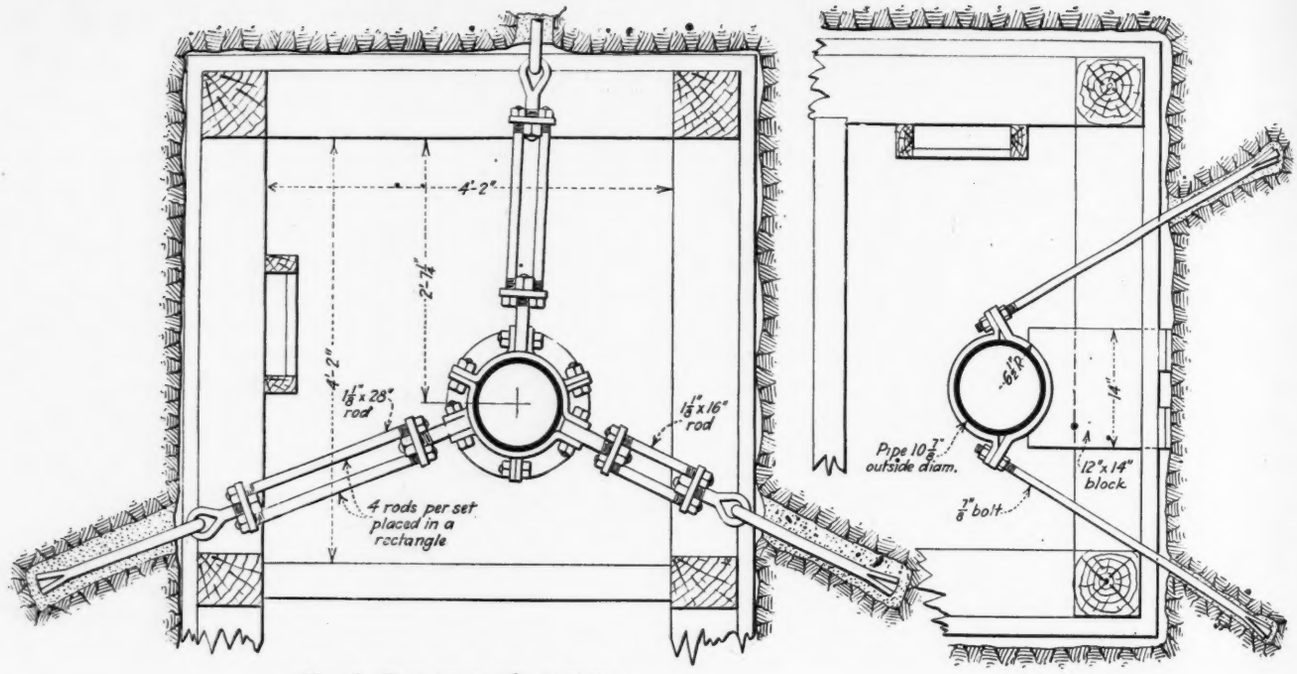


Fig. 2—Two types of supports used on a 1,700-ft. vertical pipe

the desirability of an air chamber on columns from centrifugal pumps. Ordinarily this is deemed necessary only for reciprocating pump installations to smooth out the plunger pulsations. As a matter of fact, however, air chambers have been absolutely necessary on some centrifugal-pump installations to prevent breakdowns from the shocks caused by sudden closing of check valves. While air chambers are desirable on vertical pump columns, they are also necessary on long runs of low-head piping, where quick-check valves cause water-hammer. Pump casings have been burst from this cause, particularly where no outlet check valve was provided or when it failed to function and the inlet foot valve took the shock. As a further prevention it may be well to consider using slow-closing check valves, of which several designs are available. For extreme cases it may even be found necessary to use hydraulic relief valves.

In the past, one of the drawbacks of centrifugal pumps has been a gradual wear of the sealing rings between the runners and the casing. This caused leakage from the discharge to inlet side, resulting in a falling off of capacity and efficiency. It has generally been considered necessary to renew the wearing rings, if not the runners, to restore normal operation. In modern designs the clearance is decreased and the wearing surfaces are faced with a hard material like stellite. This practice requires accurate grinding for a good fit. With old designs of babbitted bearings the small clearance desirable would not have been possible. With the ball and roller bearings now being used, the clearance can be reduced to where the leakage is very small. This, in turn, minimizes the wear, as well as maintains capacity and efficiency.

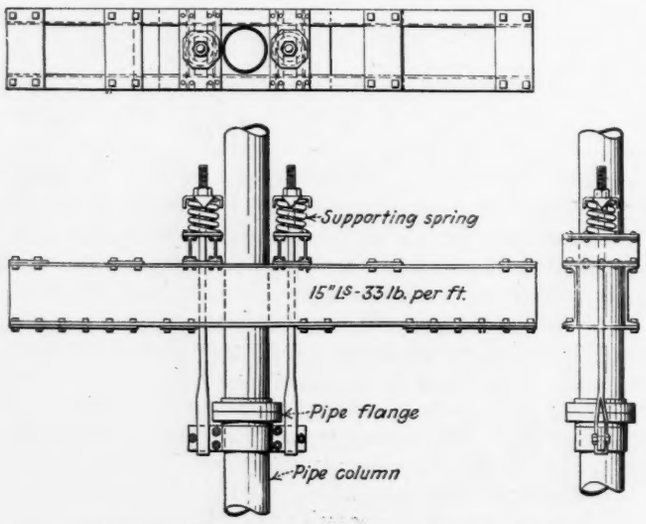


Fig. 3—Method of taking part of the vertical load off a long pipe column

Another old difficulty is rapid grooving of pump shaft sleeves in the stuffing boxes. To maintain tight seals and good vacuum the packing is usually compressed so tightly as to cause undue wear and loss of power. With pressure on the pump intakes it will be found unnecessary to set up the packing so tightly. It may, in fact, run quite loosely, and if grease-lubricated it may run freely. A water seal is often advantageous, though not entirely necessary, if the inlet be under pressure. Should it be found advisable to use a water seal, wear of the shaft sleeves can be minimized by using filters on the water admitted to the stuffing boxes, particularly if the water being pumped is muddy or gritty.

Older designs of centrifugal pumps had a tendency to overload if the discharge head was lowered. Normal operating conditions of head and capacity of any particular pump might be at a point fairly well down on the characteristic curve, requiring a motor of a certain size. This motor might be inadequate under the condition of increased volume resulting from lowered discharge head. Pumps can now be designed with so-called self-regulating characteristics. In pumps of this design the head-capacity curves have strongly marked droops at their ends, so that the pumps will deliver only just so much water and no more with a fall in head, thereby definitely limiting the horsepower demand. While, in a certain sense, practically all centrifugal pumps have this characteristic, nevertheless the point chosen on the head-capacity curve is usually so far down as to make it possible, by lowering the head, to overload the motor by several hundred per cent. For conditions where there

may be considerable variation in the discharge head it is well to investigate the characteristics of the pumps considered with reference to this point. By so doing it will be possible to specify a size of motor which need never be overloaded and yet keep it within moderate limits.

In planning new pumping installations it is not sufficient to simply call for bids on pumps of so many gallons per minute against so many feet of head. Let the complete performance curves of each pump offered be obtained and studied. These should include not only head-capacity characteristics, but also those pertaining to speeds and efficiencies. In general, pump manufacturers are represented by high-grade engineers who are glad to co-operate with prospective customers in working out the best arrangements. It has been a pleasant experience to meet among such engineers men who if unable to supply the particular equipment required say so frankly and even recommend a competitor's special design. That policy, of course, puts such representatives into particular favor for future business. With present willingness of manufacturers to furnish full information, it is now possible for the field engineer to lay out efficient installations.

▼ ▼ ▼

Low-Temperature Refrigeration for Packaged Products

By R. S. Wheaton

QUICK FREEZING of consumer cuts of meats and fish that are packaged for distribution has received a tremendous amount of attention in the past year or so because of the new avenues of distribution which this process opens up. The basic idea under which this method works is: Meat or fish frozen quickly at temperatures of 25 to 30 deg. below zero has the water in the cell turned into ice crystals, which are so minute that the cell walls are not ruptured, and consequently there is no injury to the product.

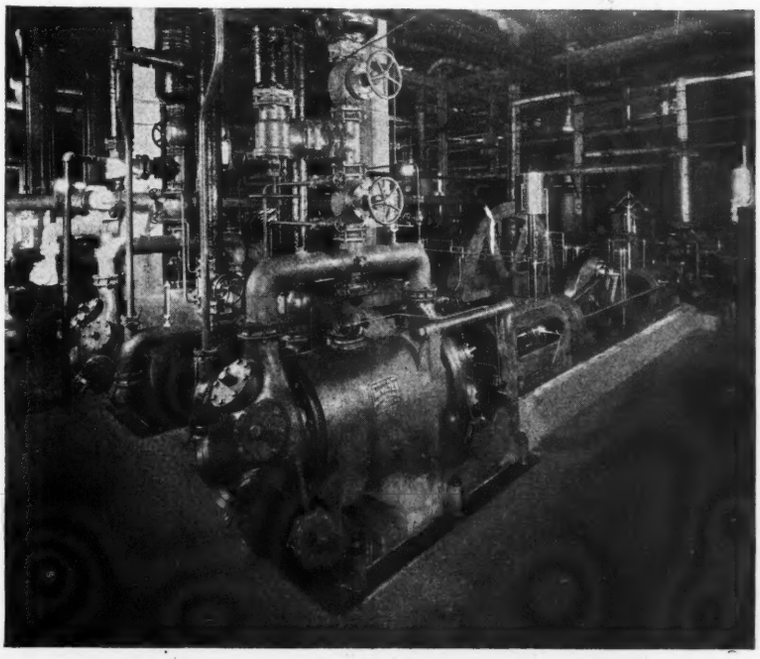
H. D. Hunt, general superintendent of Cudahy Brothers Company, Cudahy, Wis., was in charge of a project that led to the building of a plant to freeze 150,000 lb. of hams and bacon down to a temperature of —59 deg. F. in twelve hours.

The ammonia compressor is of the so-called "booster" type, in that the gas is taken from the coils in the freezer room at 20 in. of vacuum and discharged into the suction of other compressors operating in the rest of the plant at from 15 to 20 lb. pressure. This involved very careful engineering, because the temperature of the suction gas at 20-in. vacuum is —63 deg. F., and special attention to valves, stuffing box construction, and lubrication was necessary. The compressor is of the Vilter horizontal double-acting duplex design, with 21x36-in. ammonia cylinders driven by 21- and 28x26-in. cross-compound steam cylinders, rated at 120 tons refrigeration and 125 indicated horsepower.

In building the freezer room considerable insulation and piping was deemed necessary, and as a result 12 in. of sheet cork was used on the top, sides, and bottom. To provide the cooling 29,000 ft. of 2-in. pipe was installed, giving a ratio of one foot of pipe to a little less than one cubic foot of room space. Freezer burns, caused by the circulation of air over the meat, are avoided by so arranging the pipe as to eliminate almost entirely any movement of air in the room. The piping was placed in numerous layers around the walls and on the ceiling and was also built in stacks down the length of the room.

It was found that the best temperature at which to charge the meat into the room and start the freezing was —25 deg. F. After the room is charged the compressor is started on the regular run. During the first hour all the meat temperature drops to about 29 deg. and the room drops to —30 deg. Then for the next four hours the meat holds at 29 deg. while its latent heat is being extracted; during these four hours the room temperature goes down slowly to about —35 deg. With the beginning of the fifth hour, and continuing through to the twelfth hour, the temperature of the meat drops rapidly to —50 deg. and the room temperature continues a gradual descent from —35 to —55 deg. F.

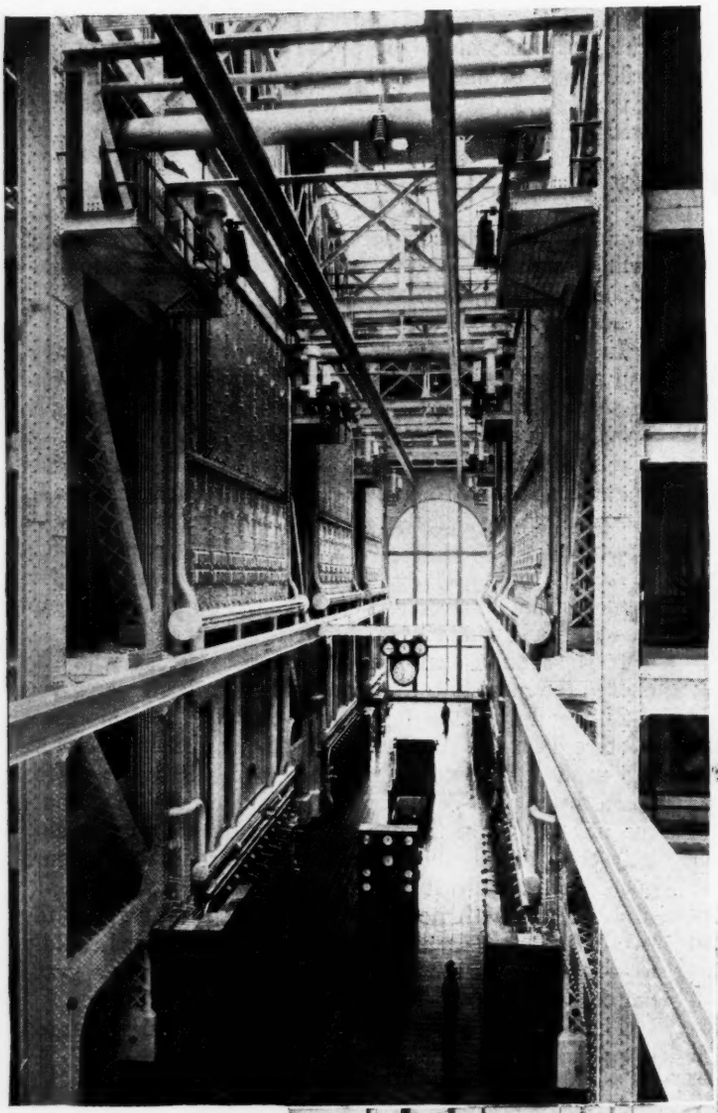
The room is then ready to be emptied and recharged in preparation for the next twelve-hour run.



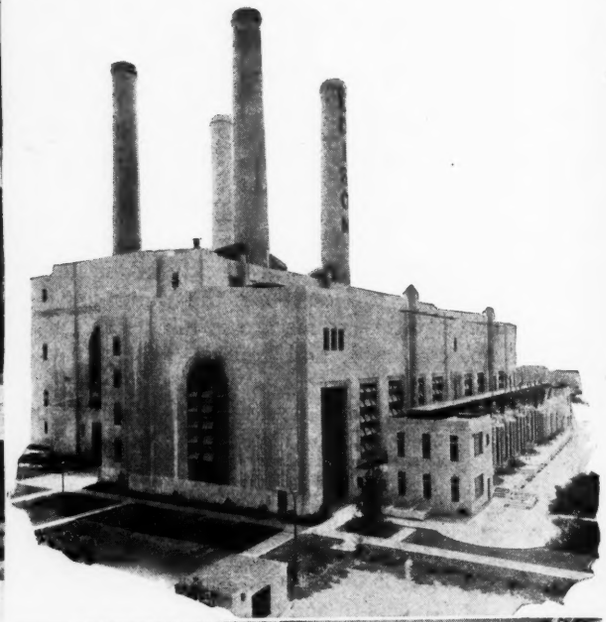
The ammonia-cylinder ends of the cross-compound steam-driven compressors used in the Cudahy plant to give the refrigeration needed to freeze meat at 25 deg. below zero

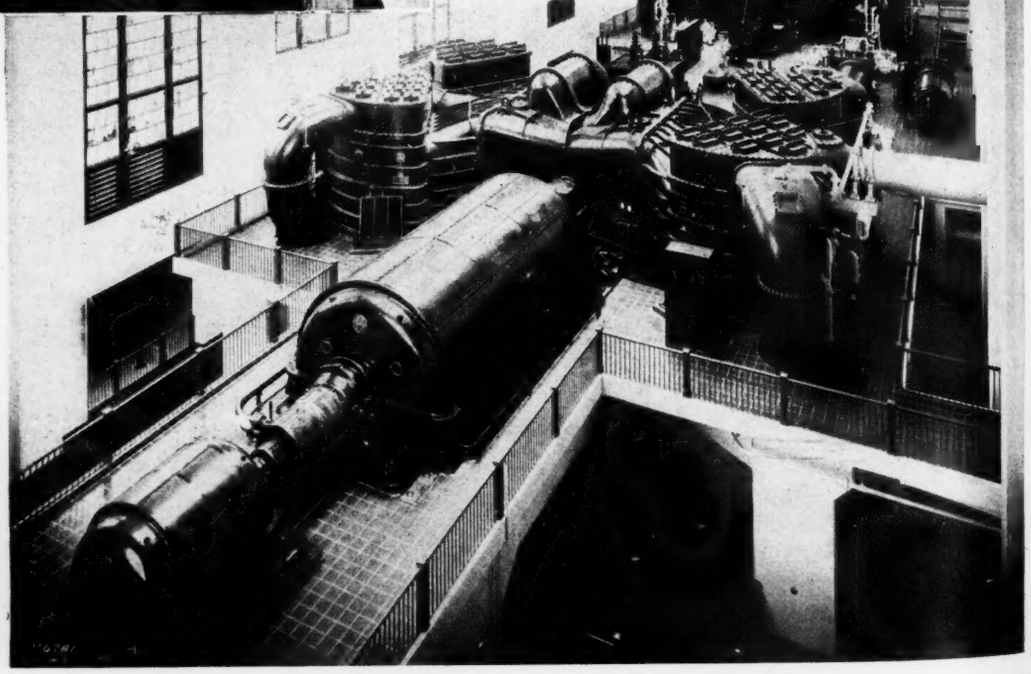
▼

POWER PLANT DE LUXE . . .



PLANT NO. 3 of the Southern California Edison Company's Long Beach steam station, where wax for the boiler room floor costs nearly a quarter of the amount spent for lubricating oil and complete automatic control enables operation by fifteen men, including the watch engineer in charge of each shift





Spotless, this boiler room contains six 34,162-ft. cross-drum boilers supplying two 100,000-kw. tandem-compound turbine-generators, shown at the right. Maximum capacity of the boilers is 450,000 lb., with normal operation at 350,000 lb. per hour of steam at 450 lb. pressure and 750 deg. F. total temperature. Furnaces are entirely inclosed by water-cooled walls and are equipped with combination oil and gas burners under complete automatic control. Natural gas is burned most of the time.

Klingenberg and Westwerke Stations

of "Berliner Städtische Elektrizitätswerke Akt.-ges."

By Ely C. Hutchinson
Editor of Power

[My previous letter (published last week) told of a visit to the great brown coal station of this same company at Golpa-Zschornewitz.—E.C.H.]

Dresden, July 11, 1930.

KNOWN AS BEWAG, the company is owned by the city of Berlin but is operated as a private company at profit-making rates that pay regularly a 10 per cent dividend after all capital, depreciation, and amortization charges. I am told on good authority that bonuses are paid to those in responsible charge, upon earnings over a certain amount.

It would seem that the electric utility business in Germany is not subjected to the strict regulation we are accustomed to in the United States.

The electricity demand of BEWAG has grown greatly in the past few years. The coal consumption has increased from 249,000 metric tons in 1924 to 786,000 in 1929. The year 1930 is conceded to be less than 50 per cent of normal, so it is not included.

Klingenberg station was built in fifteen months, in response to the growing power demand, and started operation in December, 1926. It is a splendid structure of brick built on the bank of the River Spree near a public swimming inclosure into which the condenser water is discharged when desired.

An open air coal storage of 100,000 tons takes care of all normal and emergency requirements. The coal slacks badly and the wind blows great clouds of dust, but I am told there is no complaint.

Pulverized fuel from a central system is burned, and numerous methods of reducing fly ash are in use. Electrical precipitation has been the most successful so far. All ash is hydraulically transmitted to duplicate settling basins, which are alternately emptied.

Water-tube boilers are used and all are suspended from the overhead steelwork. Steam pressure is 526 lb., and superheat 777 deg. F.

There are three 80,000-kw., 1,500-r.p.m. turbines, and three 10,000-kw., running at 3,000 r.p.m. These latter machines are bled at 50 lb., abs. to supply heating service in Lichtenberg, near by. A hot house of 12,000 square yards area, a thousand feet from the power house, is heated with steam bled from the house turbines and is made to produce off-season crops of tomatoes and cucumbers.

There are no unusual features in the equipment. The station nevertheless is a fine example of thorough-going design and execution. All the latest control and protective equipment is installed, and the extreme cleanliness and order throughout is a pleasure to see.

Westwerke station is the latest, and one of the largest. Construction work is well along, and it is expected to be put into service in September or October of this year. Although located also on the Spree, it is in quite another direction from Klingenberg and several miles distant.

As with Klingenberg, coal is delivered by canal or river barges. The new station will, however, have high-walled concrete coal bunkers to avoid the blowing of dust by the high winds.

The chimneys are supported above the boilers directly on the steel structure of the building. To make them as light as possible, with the necessary strength, they are constructed in skeleton form of reinforced concrete and the panels between are filled with an inner lining of interlocking fire tile. A block of light-weight porous concrete follows, and outside that is a facing of hollow interlocking tile.

There are eight sectional boilers generating steam at 398 lb. and 787 deg. F. The furnaces are fitted with the latest model Taylor stokers.

Practically all the steam pipe bends are deliberately crimped on their inner radii to give added flexibility. What this does to the pressure drop does not seem of particular concern.

There are six 34,000-kw., 3,000-r.p.m. turbines, and two 12,000-kw. machines of the same speed, making the total station capacity 228,000 kilowatts.

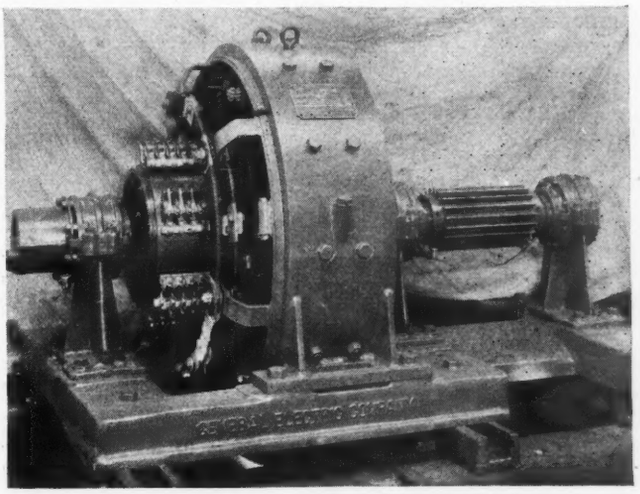
One cannot but be impressed with the rugged and substantial appearance of all the construction and the methodical manner in which it is carried out.

My next letter will tell of a visit to the Niederwartha pumped-water storage plant of the Saxony Power Company.

Direct-Current Motor Drives Towboat

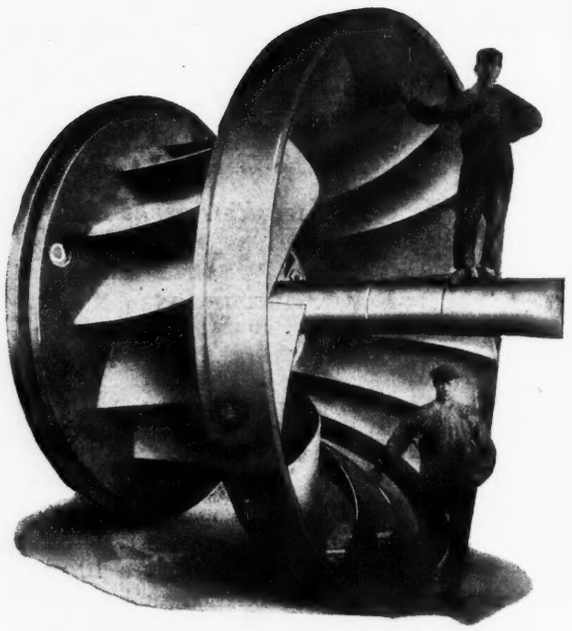
IN THE figure is a 150-hp. 460- to 700-r.p.m., direct-current propulsion motor for one of the two United States Engineers Corps towboats Scott and Fort Armstrong, of the stern paddlewheel type. One will be stationed near Huntington, W. Va., and the other, near Rock Island, Ill.

The motor is shown in the General Electric shops at Schenectady, where it was built. It has three ball bearings and will drive the stern wheel through a chain by means of the pinion on the shaft extension. In operation the motor will adjust itself automatically to the load by means of variable-voltage control.



Motor will be connected to its load by a chain drive

LOW-HEAD Francis Turbines FOR SWEDISH HYDRO PLANT



Runner buckets are made of steel plate and cast into the hub and band

By GEORGE WILLOCK
Engineer Nydqvist & Holm A. B.
Trollhattan, Sweden

Two 15,600-hp. Francis turbines, set in reinforced concrete spiral casing of special design operate under a head of 64.5 ft. developed 93.2 per cent efficiency on test. The water was measured by current meters

ONE of the interesting features of the Hammarforsen plant, on the Indal River in northern Sweden, is that the falls date back to only 1796. A canal was cut to float lumber out of Lake Ragunda to avoid using the natural outlet stream, which had a fall of about 100 ft. After the canal was cut scouring action set in and did not let up until the lake was partly drained and a falls formed at a ledge of rock in the canal route. The dam is built at the falls and the plant is constructed in one end of the dam.

A variation of about 16 ft. occurs in the head-water level, and the tail-water level may change as much as 20 ft. The head on the plant ranges from 64.5 ft. during the dry season to 44 ft. at flood periods. The initial installation in the plant is two vertical-shaft, single-runner Francis turbine units. The turbines were ordered for a capacity of 15,450 hp. each under a net head of 64.5 ft. at a speed of 93.8 r.p.m. and a discharge of 2,476 cu.ft. per second. On test the output at the specified head and water volume was 15,600 horsepower.

A cross-section through the plant is shown in Fig. 1. Short penstocks connect the forebay with the turbine's scroll cases. Each penstock is divided by a vertical wall passing down its center from the intake to the scroll. Gates are in the intakes to the penstock, each gate in two sections, one above the other, to take care of a water depth of 30 feet.

The scroll cases are so designed that their bottoms are virtually at right angles to the vertical walls and curve slightly toward the turbines, while the roof forms a sharp angle connecting the vertical wall with the upper foundation rings. Care was taken to design the scroll case so that the water velocity will be the same at all points in the circumference.

Cast-steel guide vanes are used, each supported in bronze bearings. The spindles are cast into the vanes and are connected to the operating ring by the usual arrangement of levers and links. To insure free movement of the operating ring it is supported on rollers. The crown plate is made of cast iron and is built in sections. It is heavily reinforced to carry the operating ring and the guide bearing. This plate is supported in the upper foundation ring, which forms the connection to the scroll case.

The buckets in the runners are made of steel plate, pressed to shape and cast into the steel rim and hub. The runners have a maximum diameter of 13 ft. 1.5 in. and weigh 21.5 tons each. The weight of the rotating parts and the water thrust, amounting to a total load of about 200 tons, is carried on a thrust bearing on top of each generator.

The guide bearing on top of the crown plate has a white metal lining, lubricated by a spur-gear pump driven by gears from the turbine shaft, as indicated in the section of the turbine lubricating system, Fig. 2. From the pump the oil goes to the receiver above the bearing. The receiver is provided with a float that gives an alarm if the oil level falls below a given point.

Movement of the guide vanes is by two servo-motors mounted just above the turbine's crown plate, on a level with the operating ring. The servo-motors are operated by oil pressure supplied by a gear pump driven by a direct-coupled electric motor. The oil pump and motor, together with the pressure-receiver, are on a common bedplate and are installed on the generator room floor. The oil reservoir is in the floor immediately below the pump. The pumps and pressure receivers for the two

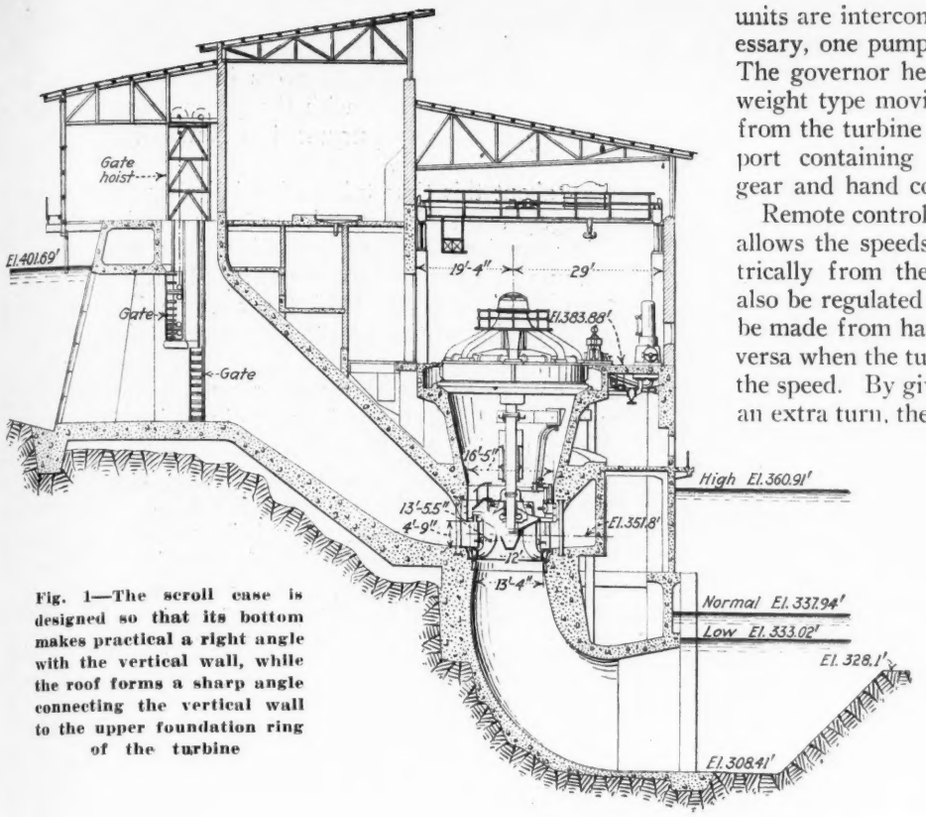


Fig. 1—The scroll case is designed so that its bottom makes practical a right angle with the vertical wall, while the roof forms a sharp angle connecting the vertical wall to the upper foundation ring of the turbine

units are interconnected by piping, so that, if necessary, one pump can supply oil to the two units. The governor head, of the combined spring-and-weight type moving on knife-edges, is belt-driven from the turbine shaft, and is inclosed in the support containing the main valves, compensating gear and hand control equipment.

Remote control is provided for the governor and allows the speeds of the unit to be adjusted electrically from the switchboard. The turbine can also be regulated by hand, and the changeover can be made from hand to automatic operation or vice versa when the turbine is running without affecting the speed. By giving the wheel for hand operation an extra turn, the guide-apparatus can be locked in closed position. A section through the locking device is shown in Fig. 2. This device consists of a movable cylinder on a stationary piston with suitable ports to admit pressure oil to move the cylinder. When the cylinder *P* is in the out position, as in the figure, it is in a hole in the operating ring and prevents the gates from opening.

As can be seen from Fig. 3,

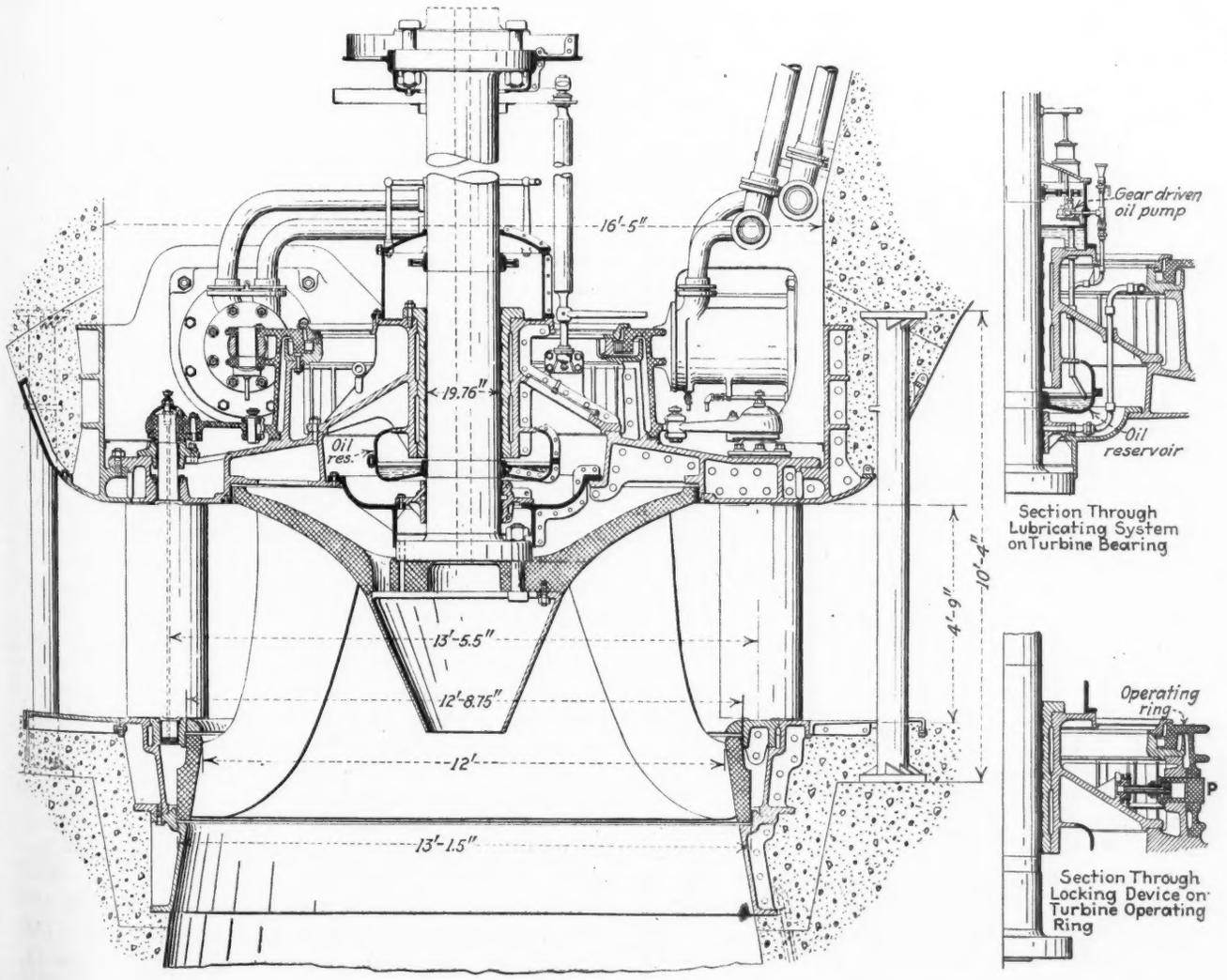


Fig. 2—Section through one of the turbines, its lubricating system and operating-ring locking device

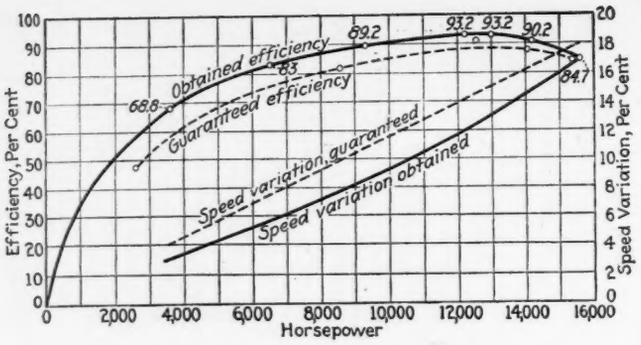


Fig. 3—Efficiency and speed-regulation curves

the test performance of the units was considerably better than guaranteed. For instance, the highest efficiency obtained was 93.2 per cent, which is exceptional for this type of turbine. The water was measured by current meters placed in the intake to the penstocks. The head was measured directly and taken as the difference between the head-water and the tail-water levels. On the electrical end the output was measured by the two-wattmeter method, the generator being loaded by a water resistance. This resistance could be regulated by raising or lowering the electrodes in the water. The measurements were carefully made, the output of the turbine being determined by adding to these readings the losses in the leads between the generator and the instruments. As can also be seen from the speed variations obtained on test, they were well below those guaranteed.

The turbines and governors were supplied by Nydqvist & Holm A. B., Trollhättan, Sweden. The civil engineering work was done by Aktiebolaget Vattenbyggnadsbyran, consulting engineers, Stockholm. This firm also made the tests on the units.

Condenser Tube Experience at Williamsburgh Power Plant

THE Williamsburgh power plant, located on the East River, Brooklyn, N. Y., supplies power to the Brooklyn-Manhattan Transit Corporation. Condenser circulating water taken from the East River has proved particularly hard on condenser tube material, and the station has for years been a proving ground for various tube materials. Condenser maintenance, including cleaning of tubes, has varied in the last eight years between $77,000 and $123,000, which reflects the high cost of condenser tube renewals and the necessity of frequent cleaning of the tubes.

The tube history of this station dates back to 1906,

Muntz metal	Unsatisfactory
Admirality metal	Satisfactory
Aluminum bronze	Very satisfactory
Nickel silicon	Unsatisfactory
Bi-metallic aluminum lined copper tube	Unsatisfactory
High-copper Admiralty, copper 80 per cent, zinc 19 per cent, tin 1 per cent	Results encouraging
High-copper Admiralty, copper 85 per cent, zinc 14 per cent, tin 1 per cent	Results very encouraging

when it went into service. During that time a considerable number of tube materials have been tried, among which the seven given in the tabulation are probably the most important.

In 1909 two 20,000-sq.ft. surface condensers were put in service, the original tubes being Muntz metal. Failures began after only two to three weeks, and it was necessary to retube the condensers in approximately a year's time. This agrees with the generally recognized fact that Muntz metal is unsuited to New York Harbor water.

From about this time tubes of Admirality metal have been largely used. In general, the tubes furnished have been in accordance with navy specifications, except that a minimum of 1 per cent tin has always been specified.

From 1909 to about 1914 the average life of the Admirality mixture tubes up to 20 per cent tube failures was approximately two years. About 1914 the manufacture of condenser tubes became a very live subject, and a number of manufacturers began to investigate the possibility of making a better tube. About the same time regular and methodical condenser cleaning was started. Following 1914 the life of the tubes appeared to increase, either due to better tubes being furnished or to the cleaning that had been instituted. The life increased to approxiately three years, with 20 per cent failures, and has remained substantially at this point up to the present time. A set of condenser tubes that does not run for two years is considered poor, and tubes that operate over three years are considered good.

Typical end failures due to both erosion and corrosion characterize the failures in the Admirality metal tubes. End failures generally occur with the longer-lived tubes. Failures at any other point generally occur on the shorter-lived tubes, and this usually indicates poor quality.

Some time between 1909 and 1914 a series of tests was started on bi-metallic tubes made up of an inner wall of aluminum and an outer wall of copper. They were installed in two 20,000-sq.ft. condensers. The test was not a success, as the aluminum tubes oxidized rapidly and the heat transfer was seriously reduced. Oxide accumulated to such an extent that it was impossible to clean the tubes. Also, a large amount of end reaction took place between the tube metals, and it was necessary to install a sleeve somewhat in the manner that Flowrites are now used.

During April, 1912, 23 aluminum-bronze tubes of a composition 92.3 per cent copper and 7.7 per cent aluminum were installed. Ten years later fourteen of these tubes were still intact, and of this number nine were re-installed. At the end of thirteen years, in May, 1925, only one tube remained, and the others, which had failed, were so brittle that they were removed piecemeal. The life was three or four times the reasonable expectancy of Admirality. These tubes cost about ten cents more per pound than Admirality at the time of purchase. Manufacturers, however, are reluctant to quote on this material at the present time.

Tests to determine the effect of increasing the amount of copper at the expense of the zinc in the regular Admirality mixture of 70 per cent copper, 29 per cent zinc and 1 per cent tin are now under way. At the end of 20 months the 85 per cent copper, 14 per cent zinc, 1 per cent tin shows a 5 per cent failure; and the 80 per cent copper, 19 per cent zinc, 1 per cent tin shows 1.4 per cent. It is, however, too early to draw any definite conclusion except that the results appear to be encouraging.

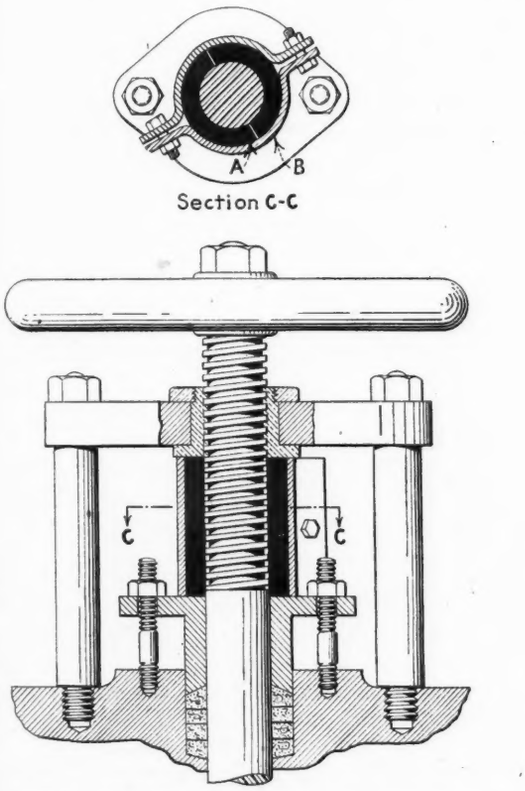
At the same time a test was started on tubes of nickel silicon. The first tube failed before ten weeks had elapsed, and the whole quantity had gone before 20 months.

. . . RIGHT OUT OF THE PLANT . . .

Valve Stem Troubles and How to Overcome Them

WITH REFERENCE to the letter of C. H. Willey in the June 3 number on "Valve Stem Troubles and How to Overcome Them," I should like to offer a method of preventing valve stems from becoming seized.

In the illustration *A* is a cylinder of compressed graphite. The graphite is mixed with a small quantity of



Graphite cylinder used to lubricate valve stem

high-temperature oil to form a binder. The halves of the graphite cylinder are held in place between the gland and stem bracket by a two-piece clamp as shown. With this arrangement the threads are lubricated each time the valve is opened or closed. J. E. NOBLE.

Lakeview, Ontario.

Pointers on Boiler Cleaning

A PROCEDURE we have used for cleaning and testing steam boilers is, briefly, as follows: For the regular period of cleaning and repairs we usually test the boiler with cold water pressure of about 50 per cent of the normal working pressure. After extensive repairs or tube replacements a cold water pressure of about 90 to 95 per cent of the working pressure is used. This is sufficient to show any leaks. Once a year we make a thorough external inspection, and before doing this we have a reliable man blow out all soot with an air lance and then take a hose with good water pressure and wash down all drums and tubes. If this is done right, it leaves the shells and tubes in a nice clean condition and greatly facilitates inspection.

By doing this once a year the guess is taken out of the work. The boilers are known to be in good condition, and a good report is assured when the boiler inspector makes his rounds. We have been doing this for more than 20 years and have never experienced any trouble. We have never found a boiler inspector that did not say that this plan was O.K. No doubt other readers could offer valuable suggestions on doing work of this kind. W. BROWN.

Ajo, Ariz.

Flywheel on Air Compressors

IN THE June 24 number of *Power* the question of the effects of inadequate and of excessive flywheel effects on synchronous-motor-driven compressors is briefly discussed in "From Among Readers' Problems." Reasons are given for the avoidance of too heavy or too light a flywheel, and the general impression to be obtained from the discussion is that a flywheel is absolutely necessary on any compressor driven by a synchronous motor.

My own observation of modern compressor practice leads me to believe that in the larger sizes of reciprocating compressors no other flywheel effect than that of the rotating field is necessary when a synchronous motor is the driving agent.

The old dictum—"Flywheels are useless with synchronous alternating-current motors, and of little use with such nearly constant-speed machines as direct-current shunt and squirrel-cage alternating-current motors"—is perhaps too sweeping. Nevertheless, large compressors of 500 hp. and over are frequently used with the rotating field as the only flywheel. These run satisfactorily and without causing the slightest surging or pulsation in the electrical system.

On the other hand, some crankshaft failures on air compressors are to be attributed solely to the use of flywheels. Such failures are admittedly rare and are only likely to occur under severe and rapid fluctuations of load. Practically all compressors are designed with crankshafts capable of dealing efficiently with load fluctuations, but it must be remembered that under such

conditions a flywheel placed between motor and load will set up reversing torsional stresses at some point in the shaft between the motor and the flywheel each time the compressor "unloads."

Prof. H. F. Moore, authority on fatigue of metals, declares "the most dangerous form of repeated stress occurs when the stress is completely reversed." The only way to prevent such reversals of stress in the shaft is to have flywheel and rotor coincident, that is, to rely upon the rotor for all flywheel effect.

A method which reduces the risk of shaft failure is to place the flywheel as close as possible to the rotor, taking care that the diameter of the short length of shaft between flywheel and rotor is amply large enough to withstand stress reversals. A bearing between the rotor and the flywheel usually constitutes a weak point in the shaft, and should be avoided if load changes are severe and frequent.

E. Scott Rivett.

Noranda, Quebec. Noranda Mines Company, Ltd.

The Banked Fire: A Neglected Opportunity

MUCH is said from time to time about "stand-by losses." In many instances the so-called stand-by losses are strictly losses due to standing by. In other cases they represent the summation of a number of individual losses which have been bunched together for convenience and called stand-by losses. Ordinarily, the stand-by loss represents fuel required to make up all radiation, condensation, and other losses, including fuel required to maintain the plant in a state ready to pick up the load. They are losses that have to be borne whatever the output of the plant. While the stand-by losses may go on without any power being generated at all, there is no reason why some effort should not be made to reduce them.

The banked-fire loss is usually bunched in with the stand-by losses. A banked fire represents an unpreventable condition. But does it not also constitute a neglected opportunity? Whether it represents a neglected opportunity to save depends upon the extent to which the coal used for banking may be reduced in any one of a number of ways. In the majority of instances the engineer does not know how much coal he is using for banking, nor to what extent he can reduce it by different methods of manipulation. Coal used for banking must not be figured in with that burned to evaporate water, though it frequently is.

How many plants keep a record of the number of pounds or tons of coal used per 24 hr. or week for banking fires? How many engineers keep this figure separately, charging it to stand-by losses; and how many include it in their "pounds of coal" used for evaporation? Whether the amount of coal used for banking is ignored altogether or is charged against evaporation is not so important as it is that something be done to determine how it may be reduced. Some banked fires are maintained for hours and days at a time, when in other cases it is only a few hours. The more frequent the banking and the greater the duration, the more important it is to keep a record of the coal consumption and the more important it is to check up the technique.

Why is it that engineers can rarely tell you how much coal is being used for banking? Is it because they think it is unimportant? And yet, in many plants the coal consumption for this purpose may vary from 10 to 30 per cent of total daily consumption. The first thing to do, it would seem, is to keep an accurate record of coal used for banking, expressed in pounds or tons per 24 hr. as a percentage of the total coal used for evaporation. It is well to remember, also, that while radiation loss may be 5 per cent at full load on the boiler, the radiation is the whole load while the fire is banked, so that adequate covering and heat insulation become all the more profitable when considered in connection with a banked fire, since the radiation loss is practically a constant loss, regardless of load.

Another opportunity to save frequently exists in the use of a lower grade of coal for banking than is used for normal operation; just as in many cases a higher grade of coal is used for peak loads than during ordinary operation. The extent to which a cheaper grade of coal may be employed depends, of course, upon the difference in price of the two grades of coal, length of time the units will be banked, and amount of coal consumption. Relatively few plants keep a record of the total number of hours that the various units are banked. Were this information available, it might point the way to operating other units at high load, so dispensing with one unit, or even more, with its banked-fire and stand-by losses.

How often are tests made with banked fires, to determine the best way to do it so as to minimize the amount of coal used? The condition of the boiler damper; the condition of the brickwork, the extent and location of the various leaks; the method of cleaning the fire, the distribution of coal, the conditioning of the coal and the fuel bed, together with the position of damper, are extremely important factors having an important influence upon the total amount of coal used. How many engineers have learned the minimum amount of coal for banking by experimenting? And how many have standardized upon conditions so that the minimum when once obtained may be maintained as a matter of daily or weekly routine? In many instances a fire is banked at a time when men are in a hurry to go home, when the peak load is over and everybody lets down "a little."

This is why it would seem that the banked fire is a neglected opportunity. Cannot someone tell how they capitalize it, and how much they save and in what ways? The banked fire is ever with us. It deserves attention.

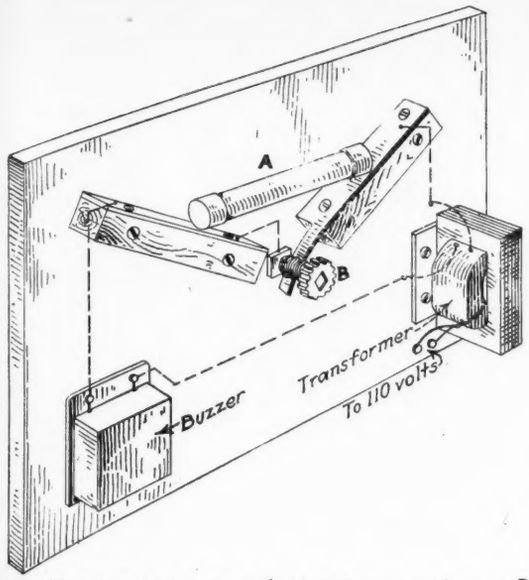
Chicago, Ill. R. K. Long.

Fuse Tester Operates With Transformer and Buzzer

THE DIAGRAM shows a panel constructed to test fuses. The parts are assembled on a wooden base about 10 in. square. Two brass or copper strips form the contacts across which the fuse to be tested is placed. The size of the strips and the angle between them depends upon the sizes of the fuses to be tested. Strips 6 in. long were sufficient for my conditions, which included 400-amp. fuses.

For testing plug fuses the right-hand brass strip was about 1½ in. longer than the other one, allowing for a narrow tongue to extend down past its supporting block, as shown. The plug fuse is tested between this tongue and a small brass plate about 1 in. square attached to the base, as shown at *B*.

An ordinary bell-ringing transformer and buzzer fur-



Cartridge fuse tested as at *A*, plug fuses tested as at *B*

nish the current and signal for testing. Low voltage from the transformer makes speedy testing possible without the shocks that are common with test leads lying about a work bench. The connections are as shown in dotted lines. A battery can be used instead of the transformer, or if it is desirable to use 110-volts direct a lamp can be connected in the circuit.

Youngstown, Ohio — DAVID WILLIAMS.

Poor Connections Cause Induction-Motor Trouble

DISCUSSION in *Power* of July 8 concerning the operation of a wound-rotor induction motor with its brushes making poor contact on one collector ring brings out the importance of keeping the secondary circuits intact by proper maintenance methods. It is doubtful if the average electrical worker realizes that a break in the secondary circuit of a motor of this type may result in severe damage, even complete burn-out. Apparently, little has been published on this subject.

Recently the current in an industrial plant feeder was widely fluctuating, as shown on a graphic ammeter. The trouble was traced to a 200-hp. wound-rotor induction motor, which was found to be vibrating badly. In addition, two leads from the collector rings to the controller were extremely hot. It was found that the brushes on one collector ring were making poor contact, due to dirt's preventing them from sliding in their holders. The collector ring had not yet become appreciably burned or pitted. The vibration and excessive heating disappeared when the brushes were cleaned.

Wound-rotor motor troubles can develop from other causes than poor brush contact. A 150-hp. motor was reported to be running hot. It was found that a contact finger in the controller had been broken by catching on a contact segment. The effect was the same as if the lead to one collector ring were broken. Two of the three collector rings were badly burned, apparently caused by the excessive current burning the sides of the brushes to such an extent that sticking resulted. Operation of the motor was normal after these troubles were corrected.

A 5-hp. wound rotor motor was found to be hot. The cause of the trouble was seemingly a broken resistor grid, which, though once temporarily repaired, had attained high resistance due to burning and arcing. It was not feasible to take the motor out of service to properly repair the grid, therefore the motor was kept cool for several days by blowing compressed air on it. The grid that was known to be defective was repaired by acetylene welding, using a small flame. While this repair work was under way another grid in a different group was found to be completely broken apart. It, too, was repaired by welding. The motor's operation was entirely satisfactory after the defective grids were repaired.

I think it is evident from the foregoing that wound-rotor motors must be given careful attention at regular intervals. The stator winding must be properly protected by fuses or relays, otherwise trouble in the secondary circuit may result in serious damage. In fact, in some cases it may be advisable to install relays in the secondary leads that, under abnormal conditions, will disconnect the motor; because the percentage of increase in the secondary current is much greater than in the stator, or primary, current.

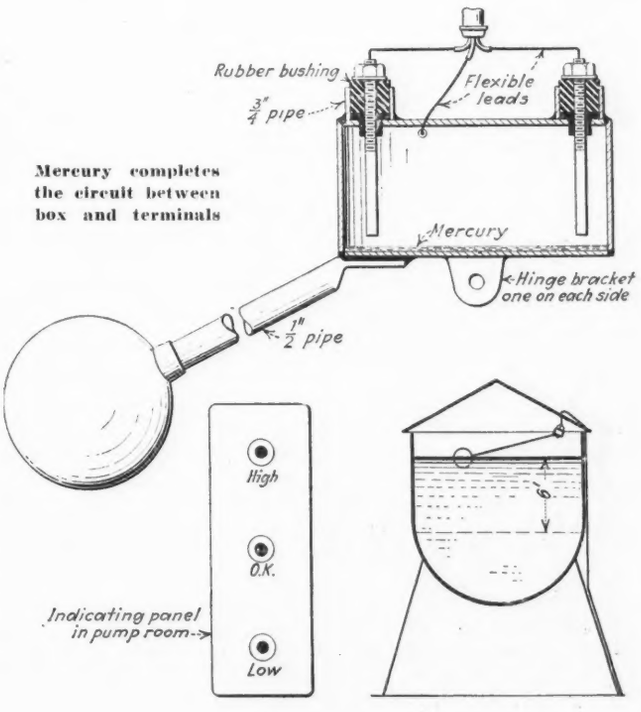
ARTHUR MAY.

Bakersfield, Calif.

Mercury-Type Tank-Level Gage

THE ACCOMPANYING ILLUSTRATION shows a tank-level gage that has been in operation at this plant for about a year and has proved reliable. To change the range of the gage it is only necessary to add mercury or change the contacts' adjustment. The contacts are held in position by tightening down on the rubber bushing. The box is made of steel, and the contacts of welding-rod steel. The terminals are made of commutator brush pigtails soldered into a hole drilled in the contacts. The ground terminal is connected to the building ground and the other terminals are connected to signal lights in the pump room. We have an O.K. light to show when the system is in service, as we should not otherwise know when the power was off the line.

Ashville, Ohio — P. J. BOZMAN.



From Among Readers' Problems

Conducted by
L. H. MORRISON

OPERATION OF LEBLANC AIR PUMP—*What is the principle of operation of the Leblanc air pump?* A.H.M.

The Leblanc air pump resembles somewhat a reverse Pelton waterwheel in conjunction with an ejector or funnel-shaped nozzle that is connected with a space containing non-condensable vapor and air to be withdrawn by the air pump. Sealed water is introduced into a chamber central with the wheel, from which it passes to a port at the periphery.

The wheel is rotated at a high velocity and the water, being caught up by the blades, is carried through nearly a complete circumference and then "hurled" tangentially into the discharge cone in the form of thin sheets having high velocity. These sheets of water meet at the contracted part of the discharge cone and thus form a series of water pistons, each of which entraps a pocket of "air" and forces it out against the atmospheric pressure. In passing through the air pump, the sealing water receives practically no increase of temperature, and the same water can be used over and over again.

RETURNING CONDENSATE TO BOILER BY GRAVITY—*Our laundry is equipped with several ironing and pressing machines and dry rooms, all of which are supplied with steam at boiler pressure. The condensate from the machinery and dry rooms is received in separate traps which discharge to a return trap that returns the condensate to the boiler. As the dry room and all machinery are 20 ft. above the boiler, would it not be better to remove the traps and return the condensate to the boiler by gravity?* C.E.H.

Gravity return of the condensate is possible only when the pressure in the machine or coil, plus the pressure due to the head of water in the return pipe, is greater than the pressure required for overcoming pipe friction, plus the pressure in the boiler. When the coils and machinery supplied with steam are 20 ft. above the water line of the boiler, the pressure due to the head of water in the return pipe at the boiler-water level would be $20 \times 0.433 = 8.66$ lb. per square inch.

Neglecting loss of pressure due to friction in the return pipe, the water could not be returned to the boiler by gravity for any pressure in the steam spaces of the machines or heating coils if more than 8.66 lb. per square inch below the pressure in the boiler. For instance, if the boiler pressure is 60 lb. per square inch and the loss of pressure for overcoming the friction of flow in the return pipe is 1 lb., then the lowest pressure that could be maintained in the coils or machines and effect a return by gravity would be $60 - (8.66 + 1) = 50.34$ lb. per square inch gage.

It might be possible to maintain dry-room coils with less drop of pressures, but for ironing machines, etc., it would be impracticable to depend on so little reduction of pressure, from the fact that steam-heated machinery usually is designed to have the supply modified by throttling the steam at the supply valves, according to the room temperature and the amount of heat required for satisfactory operation. Very frequently in steam-heated machinery of this kind, the actual operating pressure is so much lower than the boiler pressure that 20 ft. drop to the water level of the boiler does not afford enough additional pressure to overcome the pressure of the boiler and, for certainty of operation of the machinery, it would not be advisable to dispense with the traps and depend on returning their condensate by gravity, although that may be practical for the dry-room coils.

FLAME TEMPERATURE WITH PULVERIZED COAL—*What kind of flame should be carried with pulverized coal?* M.M.

The article by C. H. Camp in the July 8, 1930, number of *Power* should be helpful.

The character of the flame is an indicator of proper flame propagation and efficient combustion. For horizontal firing best results are obtained with flames that are stable and not more than 4 to 5 ft. in length at moderate ratings. Stabilization of flame is a characteristic of good combustion. It is difficult to maintain with high- or low-volatile coals, and especially difficult with coals having slow-burning characteristics.

Long, flickering, or pulsating flames, or floating, partly burned solids, are characteristic of poor combustion. High-volatile or slow-burning coals usually produce these results. With low-volatile coals large amounts of floating, partly burned solids are almost invariably observed, due to the lack of sufficient volatile, with its high heat of combustion, to accelerate the burning of the solids long enough. Deficiency of air or poor mixing of air with combustible will also produce the same results.

Long flames result in impingement and damage to rear walls. When this occurs it is usually found that a high-volatile coal is being used, although it can be brought about with lower-volatile coals by having the velocity of the mixture in excess of flame propagation or by the use of an excess portion of secondary air.

ALIGNMENT OF TURBINES—*What are the general steps involved in aligning a turbine?* P.R.C.

A turbine unit is in proper alignment when the bearing supports the shaft properly without any twist or improper distribution of weight. Couplings should match up both central and parallel. When the machine is cold, the couplings are not necessarily central, as the turbine usually expands more than the generator. So in order to be properly lined up when the machine is at running temperature, the shaft will not be at the proper level at the turbine when the latter is cold. This is because the turbine naturally contracts more vertically than the generator. The cylinder, or wheel, casing should be lined up central with the shaft under running conditions, which will not necessarily be central when the machine is cold.

Small turbine-generator sets are usually bolted together rigidly, so there is no tendency for them to get out of line. They are usually built with only two bearings. It is, therefore, necessary to align such machines, and they are merely set on the foundation in the proper location.

Medium-size units usually are assembled on the bedplate, but must be lined up carefully. The manufacturers have several methods of checking alignment. One is to level up the bedplate. Another method is to test the alignment at the coupling of the machine.

Some manufacturers place machined pads on the bedplate of the turbine for leveling, so that a machinist's level can be used on the pad. These pads, situated in different places, must all be brought to a dead level by adjusting the wedges under the machine. Another method is to use small machined pads, and then a straight edge must be used with a level. The straight edge is placed across two of the pads and the level is placed on the straight edge. The wedges are then adjusted so that they are on a dead level, and at the same time the leveling must be correct on all of the other pads so that the straight edge and level can be placed on any two of the pads and show a

perfect level. Another method is to provide the set with a large coupling which can be readily tested by shim gages. The flanges of the coupling must be brought central and made parallel. When the machine is cold, the flanges are usually open somewhat at the top, so that under running conditions the flanges are approximately parallel. Manufacturers' instructions should be followed carefully in all such work.

Wedges for leveling are usually made 10 or 12 in. long and tapering from $\frac{1}{8}$ in. at the sharp edge to $\frac{3}{8}$ or $\frac{1}{2}$ at the thick edge. They should be placed under the bedplate, about 2 or 3 ft. apart, especially close together where weight is heavy. Leveling must be done most carefully in order to bring the machine to proper alignment. Iron blocks can be used to advantage under the wedges, in fitting up.

Sometimes machines are lined up by bolting arms to the turbines, which are doweled in place. The tops of these arms are set level or else lined up by means of a tight line. In such cases the manufacturer should be requested for all information. Accurate levels should be used; the ordinary machinist's or carpenter's level is not good enough. The proper kind of a level will show a difference of one thousandth of an inch in one yard.

PREVIOUS QUESTION

Discussed by Readers

THE QUESTION

WE HAVE a cooling pond with mud bottom and banks, and are having trouble with crawfish boring holes in the bottom and banks. What is a remedy for this trouble? Will a chemical, such as chlorine, added to the water kill the crawfish?

J. MacC.

TO THOSE who have not encountered the species, the crayfish, or as it is better known in the South, the crawfish, may seem too puny an animal to justify a campaign of extermination. Nevertheless, in crawfish land, the "pesky critters" will drill an embankment so full of holes that cave-ins may occur overnight. All in all, they present a problem, and the correct solution depends upon the size of the pond, the prevalence of the crayfish, and the amount of make-up water required.

In humid localities, where the cooling is almost entirely by convection and little is by evaporation, so that make-up is small, a chlorine treatment is probably the best. The amount to use will depend on the shape of the pond, as well as upon the volume, for the chlorine must contact with the embankment. But in localities where evaporation is high, the cost of the chlorine is prohibitive, for the gas is evaporated along with the water, so that the make-up calls for the addition of more gas.

If oil in the cooling pond is not objectionable, and it usually is not in case of condenser cooling water, the banks of the pond can be oil-treated. This requires emptying the pond or applying the oil during low water. The oil, of, say, 14 Baumé gravity, such as is termed "boiler oil," or, better still, road pitch, is sprayed on to the surface of the banks. Crawfish object most decidedly to oil and will seek other quarters.

Another solution is the application of a light cement with an air gun. The cement need not be thick—merely enough to discourage the crayfish. The cost will be small and the relief will be permanent.

From all standpoints the best cure is stocking the pond with a few German carp. These, while considered inedible by people who have eaten "real" fish, will devour the crayfish, or perhaps some of the more cultured of the latter will decide the new neighbors are entirely too boorish and will betake themselves to a pond whose owner holds a broader view of the inalienable rights of crayfish.

While offering remedies, I venture still another. Every Southern town has a negro peddler of boiled crayfish, so why not call in the local "craw dad catcher," although I must add that I could never see any advantage in trying to eat a crayfish—the effort is about as futile as flag-pole sitting.

It is possible that a small band of desperate patriotic crayfish may decide to resist the despoiling of their fair land. In this case the situation assumes a different aspect. I have never heard a crayfish Hampden discourse on his rights, but if such a heroic figure should rise there is but one escape—the power plant must be moved to another pond.

DONALD MCFEE.

New Orleans.

I AM an engineer in a chemical plant, where we store well water in a pond of some 60,000 gal. capacity. This pond has a mud bottom and the sides are of wood cribbing. We have surface waters running in, especially during a wet season, and this requires the construction outlined. At times when water is lower than normal, surface water runs in at 3 or 4 ft. below the ground level.

Plenty of sea-weed is present but I have never seen a crayfish or crayfish hole.

Technicians, to be happy, have their hobbies. My outdoor hobby is fishing. My experience has been, and I have seen this statement time and again in recreational magazines, that, to determine the proper bait for bass in a locality, one should examine the contents of the fish's craw, and if this is a crayfish, use crayfish for bait. Apparently bass are gluttons for this animal.

In our pond there always has been an abundance of bass, and I believe that is why we have no crayfish. Of course, we have the usual fish trap to prevent fish from getting into the pumps. As in our case, it may be that a chemical introduced into the water to kill the crayfish would be objectionable.

Ours is not a cooling pond, but we do have condenser water discharging into the pond, which somewhat increases the temperature, but to what degree, I cannot say. Too warm water would be detrimental to game fish.

CHARLES J. SCHMITT.

Cincinnati, Ohio.

THE CRAWFISH, being a low form of animal life, would be susceptible to exceedingly minute quantities of any form of mercury. The cheapest and best for this purpose would be mercuric chloride (HgCl, or corrosive sublimate). This should be added in small amounts, so as not to kill the birds and other small animals drinking at the pool. The advantages of this compound are that it will not affect condenser tubes or piping, and it will not evaporate, thus giving almost permanent protection.

If chlorine were used in quantity enough to kill the crawfish, the amount of hydrochloric acid formed might be objectional, because of its tendency to dissolve copper, brass, and iron when warm.

LOUIS BENTON.

South River, N. J.

A Question for Our Readers

AT WHAT RATING is one justified in adding a water wall to a 5,000-sq.ft. boiler? We are resetting two such boilers and our consulting engineer recommends the addition of the walls, although we have never had serious refractory trouble.

C.F.P.

Suitable answers from readers will be paid for and published in the Sept. 16 number

THE ENGINEER'S BO

A Critique of Values

TRUE VALUES IN BUSINESS AND BUYING. *By C. G. Padel. Published by the B. C. Forbes Publishing Company, 120 Fifth Ave., New York City. Cloth, 5 x 8 in.; 215 pages. Price, $2.50.*

ATTEMPTING to introduce metaphysical and spiritual values into everyday life, and more particularly business life, is a task of such monumental proportions that even seasoned philosophers might be pardoned for being overwhelmed by the thought of it. So involved in sensory reactions to the material world is the average man's life, that, far from being concerned with true values, there is a question in some erudite minds as to whether he even thinks.

Yet, those who specialize in the art of living assure us that a sense of values is an absolute necessity to the attainment of true civilization. And such a sense of values must include the psychic and spiritual as well as the material. Thus, it is supposed, Mr. Padel concludes that if business is to contribute anything to life but the mechanization of society, it will have to take cognizance of these elements. So with charming ease and informality he sets about the task that stumps sages in a book described by the publisher's blurb as "first aid for the purchasing agent."

Naturally his critique of values is fundamental in character. He does not trouble busy executives, harassed with the exigencies of a current industrial depression, with the metaphysical advantages of introducing Yoga breathing exercises into the production rest period. He sticks to those simple virtues that have a habit of sooner or later demonstrating their value on the balance sheet. But, out of the vast richness of his experience, he gives us a business interpretation of some of the age-old human values.

It would seem that the broad possibilities inherent in these values should by this time be fairly and fully recognized in business. Evidently that is not the case. For to quote the author, "It is not a very flattering thought that the primary occupation of most men's lives consists in devising ways and means to grab what they can before the other man gets it." So again in this book we must be reminded of the horrors of selfish materialism.

The technical side of the volume, covering standardization, inspection, economy and efficiency in buying, is expertly handled by the author and should prove of practical assistance to any agent or executive in placing the purchasing department on a paying basis.

The book as a whole, however, suffers from lack of unity due the informal way the author has of interspersing philosophical facts with material facts. Parts of it might better have been expanded into a separate volume under the title, "A Sense of Values for Business Men."

For the Student

ELEMENTS OF STEAM AND GAS POWER ENGINEERING. *By Andrey A. Potter and James P. Calderwood. Third edition. Published by the McGraw-Hill Book Company, 370 Seventh Ave., New York City. Cloth, 5½ x 8 in.; 367 pages, illustrated. Price, $2.75.*

AS AN INTRODUCTORY TEXT this book will give the student of power engineering an idea of the equipment installed in various types of plants. It is practically a reproduction of the second edition as less than 25 pages of new or revised material has been included. About 20 pages of this new material is devoted to thermodynamics. The rest is scattered throughout the book.

Unfortunately a number of the illustrations taken from the first edition are not as up to date as might be, and portions of the text will give the student an incomplete picture of present-day power plant practice.

✦

German Water Power

WATER POWER EXPLOITATION IN GERMANY. *Special publication for the Second World Power Conference, issued by the Deutsche Wasserwirtschafts und Wasserkraft-Verband E. V. with the assistance of the governmental departments of the Reich and the German States; chief editors: Fritz Lippert, Leo Galland, and Dr. Adolf Ludin. Cloth, 8½x12; 391 pages, 123 illustrations, and numerous tables; German and English edition. For sale by V.D.I.—Verlag G.m.b.H., Dorotheenstr. 40, Berlin NW 7, Germany. Price, Rmk. 25.*

SPECIALLY published for the World Power Conference in Berlin and dedicated to the delegates attending the conference, this book makes available for the first time a comprehensive review, written in the English language, of German water-power development.

It is much more than a simple cataloging of plants. It covers the geological characteristics of the country, precipitation and river discharge, and types of power plants developed to meet different conditions, and gives general statistics as to operating and economic conditions. Descriptions of individual plants are complete; and, in addition, where special construction difficulties were encountered the method of constructing the plant is described briefly.

Except in the case of the plants along main waterways, such as the Rhine-Main-Danube waterway, the plants are grouped geographically, and in this way the presentation of information as to their interrelation is facilitated.

No comment upon the book would be complete without an expression of admiration of it as a piece of exceptionally fine bookmaking. The type is large and clear; the maps and drawings are well made; and the halftone plates, printed on coated stock, are beautiful reproductions of original photographs.

✦

An Old Stand-By Revised

MECHANICAL ENGINEERS' HANDBOOK. *Lionel S. Marks, editor-in-chief. Published by McGraw-Hill Book Company, 370 Seventh Ave., New York City; 1930. Flexible binding, 4½x7 in.; 2,264 pages; over 1,300 illustrations and diagrams. Price, $7.*

SO MANY ADVANCES have been made in the several branches of mechanical engineering since the second edition of this well-known handbook in 1924, that many sections have necessarily been entirely rewritten; others have been amplified, and several new sections have been added, such as those on dimensional analysis, vibration problems, refractories, high-temperature carbonization and gas making, low-temperature carbonization, and industrial furnaces. That on welding has been considerably expanded.

The present edition contains 278 pages more than the earlier edition, but the bulk of the book has been slightly reduced through the employment of thinner paper. The number of contributors has also been increased in order that the material may represent the work of specialists in each of the numerous branches of the field. Increasing sizes, pressures, temperatures, capacities, efficiencies, etc., have been dealt with not alone by the inclusion of the latest available physical and test data, but also by technical discussions of these trends. Many of the latest standards are to be found, as well as the new steam tables embracing the high-pressure range.

In any work of this magnitude it is not surprising that there should be some omissions. These weigh small against the vast amount of excellent and useful text. It is well, however, to point them out for future guidance. Among those noted by the reviewer are the absence of any discussion of the fly-ash problem and the various methods that are being

BOOKSHELF

employed to combat it. Also, the section on stokers remains the same as in the 1924 edition, which is most unfortunate in view of refinements made in such equipment during the last five years. Moreover, the boiler outputs cited are considerably behind 1930 practice. While the chapter on power costs has been entirely rewritten and in many respects is excellent, it is well to point out that such figures represent averages for each class and should be used as such, bearing in mind that local factors frequently mean wide departures from these results.

On the whole, the authors and publisher are to be congratulated. The present work should further strengthen the prestige attained by the earlier editions.

✦

Diesel Operation

DIESEL ENGINE OPERATION. *By Charles H. Bushnell. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Cloth, 6x9 in.; 275 pages, 17 tables, 192 illustrations. Price, $3.50.*

ONLY ONE who has gone through the arduous labor of writing a book for the practical engineer can appreciate the problems encountered in deciding just what to include in the book and what to leave out. If made too technical, the reader with a limited amount of scientific information will be affronted, while if made too elementary, the opportunity to increase the reader's store of useful information is not fully realized.

The author of this volume has done a praiseworthy piece of work. Especially is his discussion of combustion interesing, since he has attempted, and almost succeeded, in presenting the theory of this very complex chemical reaction in a most understandable form. While praising his method, one might well take issue with the accuracy of his statements as to the gasification of a liquid prior to combustion. But even if an erroneous assumption has been introduced, the explanation as a whole is excellent, understandable, and thoroughly practical.

Mr. Bushnell also follows the present-day tendency to discuss the action of an oil spray based on the Laughy Field tests of spraying into cold air. There may be some good grounds for investigating cold spray, but the observed data cannot be applied to an actual engine, for in the engine, ignition and combustion so alters the spray formation that an entirely different problem is presented.

Other chapters devoted to the practical operation of a Diesel engine are good, but suffer from a lack of completeness. Even so, an operating man will find much information in them. It is unfortunate that more actual engine designs are not covered, but the rapidity of design change probably justifies the author's omission.

Criticism might be made of the decision to devote the first chapter to thermodynamics of the internal-combustion engine. After assuring the reader, in the preface, that the volume is intended for the practical engineer, to confront him immediately with an initial treatise on thermodynamics is to show a lack of consistency.

Regardless of these criticisms, which, after all, are on minor points, the author is to be praised for the excellent material he offers.

Patent Information

PATENTS, TRADE-MARKS, COPYRIGHTS—LAW AND PRACTICE. *Fifth Edition. By Oscar A. Geier. Published by Richards & Geier, 274 Madison Ave., New York City; 1930. Cloth, 6x9 in.; 128 pages. Free.*

WRITTEN in terms the inventor, engineer, and business man can understand, this book covers the essential features of patent, trade-mark and copyright laws both in the United States and abroad. It is divided into two sections, the first on patent law and the second on laws covering trade-marks.

The patent law section of the book explains who may obtain a patent, what may be patented, the importance of specification and claims, patent interferences, reissues, appeals, infringements suits, etc.

The trade-mark end of the book covers trade-marks in general, valid trade-marks, invalid trade-marks, unfair competition, state registration, interferences, oppositions, appeals, infringements, etc.

This fifth edition has been completely revised and brought up to date to conform with the changes of the law and practice since the fourth edition was issued, in August, 1928. Data on foreign law is given for the exporter.

●

Brief Reviews

STRUCTURAL ALUMINUM HANDBOOK. Compiled by the technical staff of the Aluminum Company of America, Pittsburgh, Pa. Fabrikoid, 119 pages, illustrated; price, $1.—Similar to handbooks on steel, this volume presents a brief description of the composition of structural aluminum alloys, followed by tables of areas, weights, formulas, dimensions, conversion factors, and other information useful to engineers.

GROUND RESISTANCE TESTING. Technical Bulletin 1260 of James G. Biddle, 1211-13 Arch St., Philadelphia, Pa. Paper, 64 pages, illustrated; free.—A practical treatise on the measurement of the resistance to earth of ground connections.

NEW BRUNSWICK CANADA. By L. O. Thomas. Published by the Natural Resources Intelligence Service, Department of the Interior, Ottawa, Canada. Paper, 166 pages, illustrated; free.—An interesting description of the potentialities for development of this province.

EXPERIENCES IN CHLORINATING CONDENSER CIRCULATING WATER. By Vincent M. Frost and W. F. Rippe. Technical Publication No. 112 of Wallace & Tiernan Products, Inc., Belleville, N. J. Paper, 32 pages, illustrated; free.—An account of tests run at the Kearny Station of the Public Service Electric & Gas Company of New Jersey.

THE COMMERCIAL STANDARDS SERVICE AND ITS VALUE TO BUSINESS. Commercial Standard CSO-30, for sale by the Superintendent of Documents, Washington, D. C. Paper, 34 pages, illustrated; price, 10 cents.—Elimination of waste through simplified commercial practice as recommended by the Department of Commerce.

A STUDY OF SLIP LINES, STRAIN LINES, AND CRACKS IN METALS UNDER REPEATED STRESS. By Herbert F. Moore and Tibor Ver. Bulletin No. 208 of the engineering experiment station, University of Illinois, Urbana, Ill. Paper, 62 pages, illustrated; price, 35 cents.—Experiments and conclusions on the fatigue of metals.

MATERIALS OF ENGINEERING CONSTRUCTION. By Francis W. Roys. Published by the Ronald Press Company, 15 East 26th St., New York City. Cloth, 331 pages, illustrated; price, $4.—A practical textbook covering the characteristics and properties of the most-used materials in a comprehensive manner. Explanations are brief and direct, current developments are considered, and the illustrations are numerous and useful.

THE FUTURE OF AUTOMATIC ARC WELDING IN THE BOILER INDUSTRY*

By G. H. KOCH
General Engineer
Westinghouse Electric & Manufacturing Co.

ONE has only to consider the difficulties that now beset the designer and builder of high-pressure vessels to realize that the day of the all arc-welded boiler is not far away. Already the maximum size of boilers and ultimate efficiency of steam power plants are fixed by the limitations of the riveted joint.

Compared with arc welding, riveting is expensive and inflexible. It is costly both from the standpoint of the initial tool investment and construction.

Above all, the demand for higher plant efficiencies is reflected in larger boilers and higher steam pressures. Plate thicknesses are consequently increasing to a point where riveting is out of the question. Boiler drums are already being made at great expense from seamless hollow cylinders.

Boiler manufacturers are turning toward the arc welding processes used in the construction of similar vessels for the chemical and petroleum industries. Oil-cracking stills have long been made for higher pressures and temperatures than are common in boilers. Wall thicknesses of 6 in. have been used in some enormous stills. The heaviest vessels have been made by arc welding, and not a single service failure has developed.

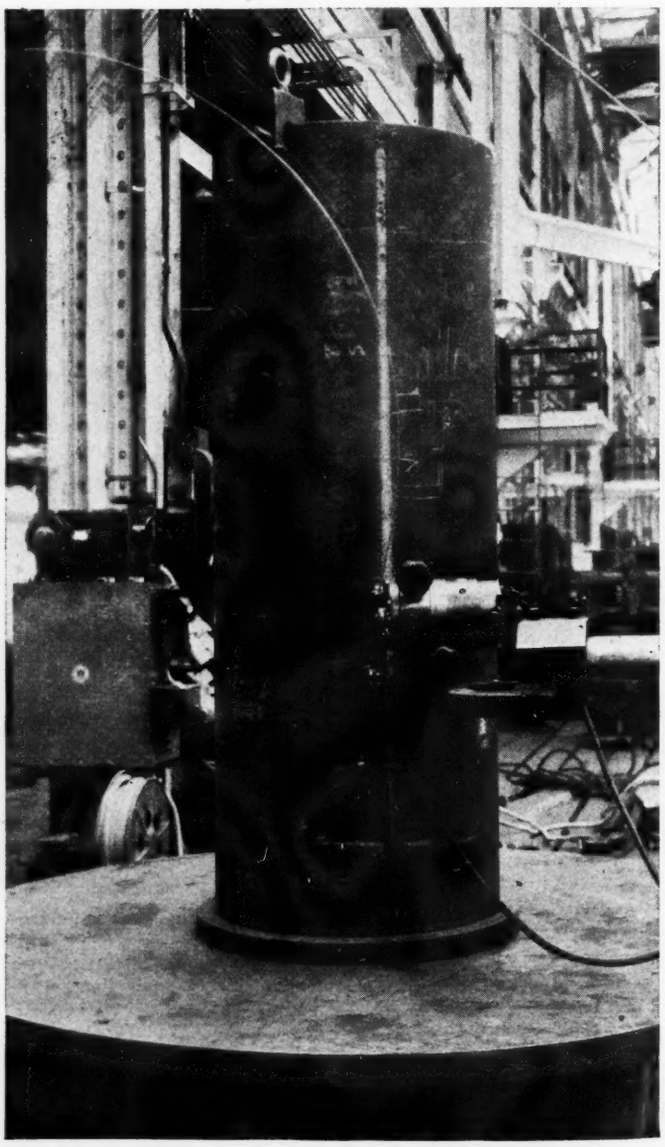
Automatic arc-welding processes with special preparation and subsequent annealing as employed in the manufacture of oil-cracking stills would serve as an ideal basis for the development of large fired pressure vessels. If such boilers were first manufactured experimentally and put into service outside of the code jurisdiction valuable test and service data could be accumulated and a precedent would be established for the gradual adoption of welding.

The general argument used against welding, of course, is that it is untried and unproved. Some of the detail objections are: First, that it is difficult to formulate a set of rules or specifications to obtain a given result regarding effective strength; secondly, that it is difficult to inspect a joint to determine the quality of the weld and the presence and magnitude of internal strains.

Similar impediments could have been raised against riveting in the early days of boiler making. They can be overcome by careful research. They have been set aside in welded vessels very similar to boilers, and with thicker walls, operating at higher temperatures and higher pressures. The welding procedure is carefully worked out to obtain ductile and dense welds with minimum shrinkage strains. Complete vessels are annealed after completion to remove last traces of internal strains, and carefully tested before shipment. Methods of exploring a finished butt weld are being developed to give an inspector a direct reading indication of the soundness of the joint. The last objections to welding are being gradually overcome.

The greatest contribution toward reliability and consistency in welding is the development of the automatic arc-welding head. It replaces the trained eye and hand of the welder to maintain thermal conditions at the arc. It can be adjusted for a given arc length, welding current and welding speed, as dictated by experience on a given plate thickness, and can be relied upon to produce duplicate results.

Welds are now being used in many structures bearing upon the safety of the public. Buildings, bridges, ships, airplanes, automobiles, and railroad rails are examples. Welding can serve in boilers as well. Its use in this field will permit of the construction of larger, more efficient, and less expensive boilers.



Illustrating the use of automatic arc welding on heavy cylinders. The flange ring at the bottom, against which a fillet weld is produced, is about 2 in. x 4 in. in section

*Excerpts from address delivered at Master Boilermakers' Association convention, Pittsburgh.

WHAT'S NEW IN PLANT EQUIPMENT

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING, TRANSMITTING AND APPLYING THE POWER SERVICES

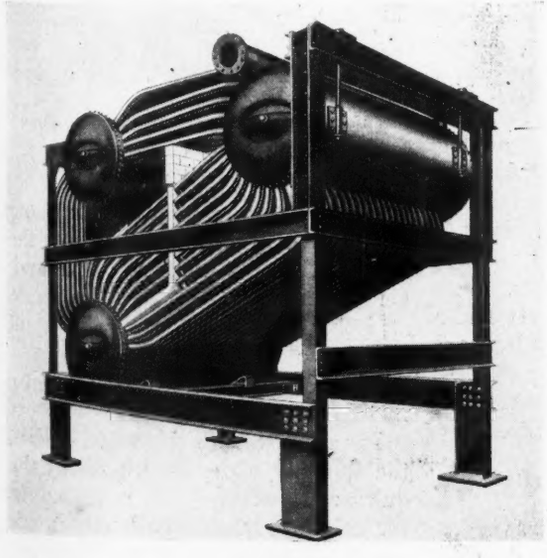
New Three-Drum Boiler

ALL THE important features of the three-drum boiler introduced a few years ago by the Erie City Iron Works, Erie, Pa., are incorporated in the new type C three-drum unit, in sizes from 800 sq.ft. up, recently brought out by this company.

Referring to the illustration, which shows a built-up design, the boiler has three drums of the same diameter connected by bent tubes, spaced in pairs to permit of easy removal. As will be apparent, the unit is suspended independently of the brickwork by a structural steel frame. This frame construction, in addition to supporting the complete unit, serves to stay the brickwork, and also makes it possible for the unit in sizes of 18 tubes wide and smaller to be completely erected in the shop and shipped built up, as shown, with the exception of the four legs, these being added in the field. In the larger sizes, which are assembled in the field, the structural steel corner supports are extended to the foundation without the use of auxiliary supporting legs.

A feature of the boiler is the use of a specially designed steam header, or manifold, placed slightly above and parallel with the front drum and connected to the top rear drum by superheating tubes. This design, in addition to giving slightly superheated steam, permits of a considerable saving in headroom, as the steam main is connected directly to the end of the header. Another feature is that the brick wall generally used with boilers of this size is replaced by a removable steel casing stiffened with angles. Provision is made in the design for the installation of a standard superheater without altering the boiler design or interfering with accessibility.

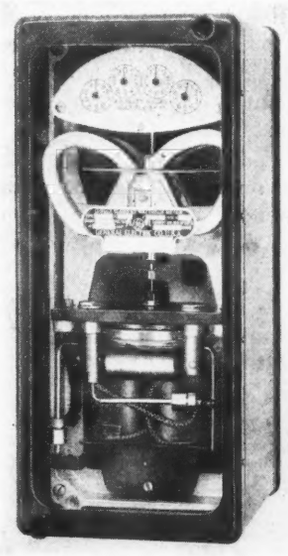
The new unit is made in three lengths and in sizes up to 40 tubes wide and 4,000 sq.ft. of heating surface.



Type-C three-drum boiler made in sizes from 800 to 4,000 sq.ft. of heating surface

Improved Mercury-Type Watt-Hour Meter

SEVERAL CHANGES in its mercury-type direct-current watt-hour meter (Type HS-11) have been made by the General Electric Company, Schenectady, N. Y. Provision has been made for periodic renewal of the mercury. The cup, now made of metal, is built as one unit complete with rotor and mercury and is easily replaceable; this removes the necessity for disassembling and cleaning the mercury chamber. The voltage characteristic of the meter has also been improved. The shunted meter is particularly well adapted where panel space or bus limitations are of major importance, its principal advantage being that it can be operated from a shunt.

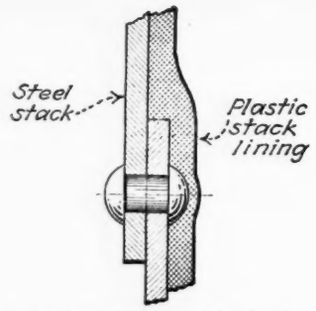


Front view of meter

Plastic Lining for Steel Stacks

A PLASTIC LINING for steel stacks, of putty-like consistency and readily applied with a trowel or gun, has been announced recently by Chessman-Elliot Company, Inc., 639-647 Kent Ave., Brooklyn, N. Y.

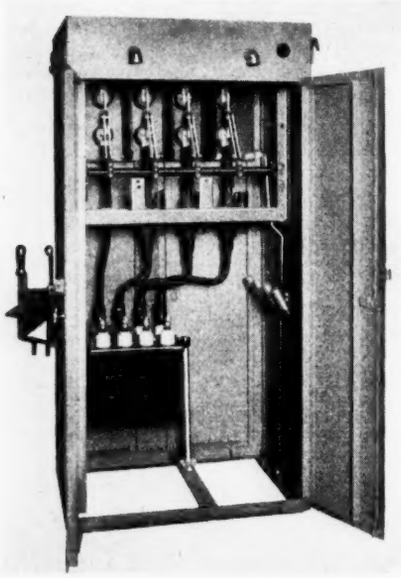
Among the claims made for this lining are that it adheres directly to the metal and forms a continuous jointless lining. It dries throughout to a dense, tough, adhesive and cohesive mass which meets the expansion, contraction and flexing of the metal. It is further claimed that, by reason of its intimate contact with the sheet, greater protection against corrosion is offered than is realized with



Section of stack with plastic lining

the standard form of brick lining. It is said to successfully withstand the abrasive action of cinders and other solid particles.

The lining may also be used before installing brick lining where the latter is desired for insulation; for facing new or old brick linings to exclude gases and acid from the masonry, and for protecting cinder catchers, flues and other construction from abrasion.



Switch house with cover open

Switch House for Transformer Vaults

A LINE of switch houses for installation in customers' transformer vaults has been brought out by the Delta-Star Electric Company, 2400 Fulton St., Chicago, Ill. The houses are complete with mounting devices for any one of four connection diagrams, depending upon the number of feeders and type of service desired. Gang-operated disconnects at the top are operated from a handle adjacent to the oil circuit breaker control handle, as shown at the left of the house illustrated. Mechanical interlocks are provided.

Phos-Copper Welding Alloys

AN ALLOY known as "Phos-Copper" for use as a general welding and brazing material for copper and copper-base alloys has been developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The alloy, it is claimed, makes strong and dependable copper and copper-base alloy joints and connects without requiring the use of a flux. It is marketed in rod and strip form and is composed, essentially, of copper and from 5 to 10 per cent phosphorus, the rod form containing slightly more phosphorus than the strip. The alloy begins to melt at approximately 700 deg. C. (1292 deg. F.) and becomes fluid at 750 deg. C. (1382 deg. F.) for the rod and 800 deg. C. (1472 deg. F.) for the strip form.

The presence of the phosphorus prevents the oxidation of both the copper and the surfaces being joined, thereby acting as a flux. At the same time, the phosphorus lowers the melting point and gives the alloy a free-flowing characteristic when fused. Tensile strength of the deposit or joint varies from 18,000 to 30,000 lb. per square inch, and is greater than that of copper, but its ductility is less than that of copper.

Starting Switch for Small Motors

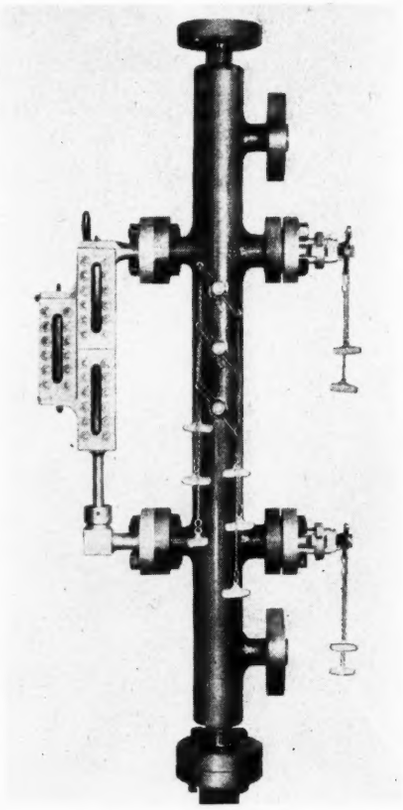
FOR the convenient starting and stopping of small direct-current and polyphase alternating-current motors, the two-pole, push-button-operated starting switch with thermal overload relays illustrated is announced by Cutler-Hammer, Inc., 190 12th St., Milwaukee, Wis.

Double-break silver contacts and a quick-break contact mechanism are used. When tripped by an overload, simply pushing the "reset" button resets the relay and starts the motor.

Two-pole push-button-operated starting switch

Water Columns and Gage Glass for 1,800 Lb. Working Pressure

THE ILLUSTRATION shows a new water column recently developed by the Reliance Gauge Column Company, Cleveland, Ohio, for



Water column with three-section gage glass

the high-pressure boilers now being installed in the new plant of the Philip Carey Company, Lockland, Cincinnati, Ohio, which is to operate at 1,800 lb. pressure and which will shortly go into service. This will be the highest operating pressure in use in this country.

In contrast with the usual design, the shut-off valves, which are of the quick-closing type, are mounted in the column instead of directly in the gage connection, as is usual practice. The water gage comprises three flat-glass sections each protected by mica and mounted in a forged-steel housing, fitted with an expansion joint at the lower end. The shut-off valves have renewable chromium-steel seats and disks and are of the outside screw and yoke type. The water gage housing it fitted with an eyebolt to facilitate handling. Other features of the design will be apparent from the illustration.

NEWS of the FIELD

West Kootenay Completes 56,000-Kw. Plant at South Slocan, British Columbia

THE West Kootenay Power & Light Company has just completed a 56,000-kw. hydro-electric development on the Kootenay River at South Slocan, B. C., thirteen miles downstream from Nelson and approximately 30 miles from Trail. This project is known as No. 3 plant and is the largest development of a series owned by the company on the Kootenay River. No. 2 plant, located two and a half miles upstream from the new plant, was constructed in 1906 to generate 26,000 kw. under a 70-ft. head, and No. 1 plant, situated midway between No. 2 and No. 3, was constructed in 1923 to generate 44,500 kw. under a 70-ft. head. These three plants utilize an actual head of 210 ft. of a total fall in thirteen miles of 270.5 feet.

The new power house at South Slocan is a building of large proportion. Its length at generator room floor, to house the generating units and provide space for switchboards and erection bay, is 251 ft. Total horizontal distance from the upstream part of the headworks to the downstream edge of the floor over the draft-tube outlets is 167 ft., and the height from the floor of the draft tubes to the top of the headworks is 125 ft. The width of the forebay at the entrance to the penstocks is 156 ft., and the distance across the tailrace at the outlet from the plant is 162 feet.

The power house was located on the downstream end of the western channel to take advantage of the natural fall in the river. It was necessary to construct dams extending upstream from the headworks structure, on the island, and also on the western shore, to impound the water in front of the headgate. The dam on the western shore is 425 ft. long, with a maximum height of 60 ft. The dam on the island side has a length of 1,311 ft., with a maximum height of 70 feet.

There are three generators, each with a diameter of 27 ft. 4 in. They are assembled directly over the turbines and are supported on massive reinforced foundations. The three turbines are of the Francis type, vertical, single runner, speed 100 r.p.m., capacity of individual units 25,000 hp. at 70-ft. head.

The switchhouse structure, 80 ft. long and 21 ft. wide, constructed of reinforced concrete, is attached to the west end of the generator room. It contains two stories and a basement. The basement contains only the main lead cables from the generators and the outgoing leads to the transformers. The structure is of the modern outdoor type, with concrete foundations and steel overhead structure. The transformer section is located 60 ft. from the end of the generator room on slightly higher ground. There is a tunnel at the back of the transformers for oil pipes, water pipes, and oil filters. When oil is drained from the transformers it will flow to tanks in a separate building.

Plant No. 3 of the Kootenay River development is shown in the foreground; No. 1 in the background

Eugene, Ore., Accepts Bids for New Steam Plant

From among the bidders on various pieces of equipment for the new steam generating plant of the city of Eugene, Ore., the following awards have been made by the Eugene Water Board in consultation with Stevens & Koon, Portland, Ore., consulting engineers on the project: For the boiler, Gordon & Finkbeiner Company, Portland, $55,020; for the turbine-generator, General Electric Company, $96,500. An Erie City boiler of 14,130 sq.ft. will be installed. The generator will have a capacity of 6,000 kw. All seven bidders on the condenser were invited to submit new bids on revised specifications.

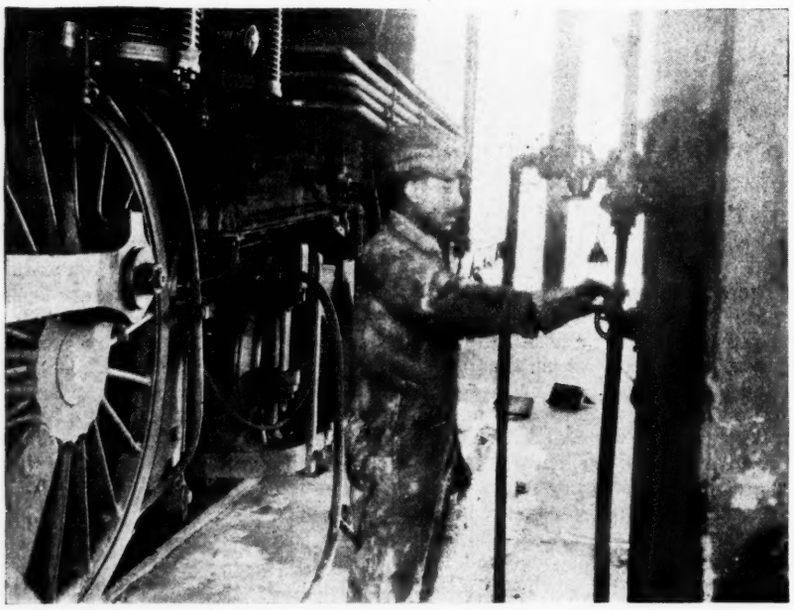
Contract for Power to Irrigate Arizona Lands

Power for pumping water to irrigate additional agricultural lands in Arizona has been arranged for under a contract recently concluded between the Arizona Edison Company and the Salt River Valley Water Users' Association, both with headquarters in Phoenix. The lands lie about 25 miles south of Phoenix, Tempe, and Mesa, and the total area eventually to be irrigated will amount to about 170,000 acres.

By the terms of the contract the company will serve the pumps with power bought from the Water Users' Association, which will build the necessary power lines and substations for the power company.

The extension program will involve the building of a 110-kv. transmission line, at an estimated cost of $188,725; a transformer substation at the terminus of the 110-kv. line, at an estimated cost of $126,000; and other works.

Warming Up Cold Locomotive Boilers With Natural Gas Effects Savings



AMONG the many modern methods used in the Santa Fe Railway shops, Bakersfield, Calif., in preparing engines for duty, is that of burning natural gas for fuel under the cold boilers. The application of gas is simplified through an overhead distribution system extending throughout the plant, from which two-inch laterals drop to each stall. It is a matter of only a moment or two to connect the hose line with the firebox of the locomotive.

In a test by experts it was found that natural gas showed a saving of 5 per cent in the cost of heating up an engine ready for service. The savings were made in fuel costs and in the elimination of blowers and atomizers.

▼ ▼ ▼

Claim Coolidge Dam Design Infringes on Patent

Complaint testimony on the Coolidge Dam patent infringement suit was completed in Los Angeles, Calif., July 26 before United States Commissioner H. H. Gordon, who is acting for the Court of Claims. The government's side of the case will be taken up in Washington, D. C., late in September. The basis for suit is an old patent of a general nature covering a conical type of dam with an increasing radius downward. This is advanced by the complaintants as applicable to the multiple arch Coolidge Dam built by the Bureau of Indian Affairs across the Gila River near San Carlos, Ariz., under the design of Major C. R. Olberg, then assistant chief engineer of the Indian Service. Col. George S. Binckley is the patentee. He has assigned a third interest in his patent to R. I. Blakeslee, his patent attorney.

After the dam was finished, Colonel Binckley filed suit against the construction company, stating that he had not realized heretofore that his plan had been used in construction. The Coolidge Dam was at the time one of the most advertised structures in the world. The court ruled that the construction firm, the Atkinson-Spicer Company of Los Angeles, was not liable and that further proceedings should be against the government through the Court of Claims. It is alleged that the use of Colonel Binckley's patented method saved 10 per cent on the cost of the dam, and thus the suit is for something close to $1,000,000.

Puget Sound Reduces Rates as Plant Facilities Grow

Reductions in rates for domestic and commercial energy to benefit the entire western and central Washington territory served by the Puget Sound Power & Light Company, have been announced by A. W. Leonard, president of the company. The reduction of ½c. per kilowatt-hour to apply in all territories where the present top step is 8c. per kilowatt-hour. The new rate will be effective for current consumed after Aug. 1, and is to be followed March 1 of next year by a further reduction ranging from ½c. to 1c. per kilowatt-hour. President Leonard announces that the rate cut is the forerunner of a series to be made, so the highest rate will not exceed 5.5c. in 1932. The present reduction is not effective in Seattle, Tacoma, or other large cities on the west side, where the present rates generally are below the 8-c. maximum.

Plant expansion, with more economical production of electrical energy, makes the rate reduction program possible, Mr. Leonard states.

"We have added a second unit to the Shuffleton steam plant at Renton," says Mr. Leonard, "giving us more than 50,000 hp. additional capacity. The Rock Island plant on the Columbia River will add 240,000 hp., and these and other extensions will provide a capacity and low operating cost which will make the 5.5-c. rate applicable generally throughout our territory probably within two years."

Merced Falls Hydro Plant Placed in Operation

Construction of the 4,580-hp. outdoor generating unit of the Merced Falls plant of the San Joaquin Light & Power Corporation, Fresno, Calif., has been completed, operating tests made, and the generator unit placed on the line. This generating unit replaces two 225-kw. Bullock generators, which have been in service over a period of 27 years. The plant occupies a site which has provided water power during a period of more than 75 years.

The height of the dam has been increased 1 ft. and the thickness 3½ ft., on the downstream face, which raised the level of the pond 6 ft. above the old level. The reconstruction is being done at an approximate cost of $330,000.

Sinclair Boilers Fired by Pulverized Coal

Contrary to the report in last week's issue, the two Babcock & Wilcox 7,500-sq.ft. water-tube boilers in the new steam plant of the Sinclair Refining Company, at Wellsville, N. Y., are fired by pulverized coal. Fuller-Bonnot mills, Fuller Lehigh circular type burners, and Bailey hopper bottom type furnaces comprise the firing installation.

It was erroneously stated in the story last week that the boilers were oil fired.

Add to Reynolds Plant

The R. J. Reynolds Tobacco Company has begun construction of additional power facilities at Winston-Salem, N. C., which will mean an outlay of approximately $200,000. The construction will include a connecting tunnel for steam lines, hydraulic lines, and electrical conduits from this plant to the No. 12 factory downtown.

Boiler, Stoker Sales Show Loss; Burners Gain

New orders for steel boilers placed during the first six months of 1930 amounted to 6,442 boilers with a square footage of 7,206,588, compared with 8,725 with a square footage of 9,743,852 for the corresponding period of 1929, according to the Department of Commerce. Despite this loss for the first half of the year, June orders show a decided increase over those for May, with a total of 1,350 boilers of 1,522,383 sq.ft., against 1,283 of 1,329,748 square feet.

The following table, prepared by the Department of Commerce from reports of 81 manufacturers who comprise most of the leading firms in the industry, presents the number and square footage of each kind of boiler ordered during the first six months of 1930, including comparisons with the corresponding period last year:

	Total 6 Mos.			
	1930		1929	
Stationary	No.	Sq.Ft.	No.	Sq.Ft.
Water-tube	601	3,163,274	851	4,960,457
Horizontal return-tubular	479	660,093	673	903,222
Vertical fire-tube	643	204,139	805	247,995
Locomotive (not railway)	107	91,603	147	122,367
Steel heating	3,554	1,607,912	5,244	2,549,888
Oil country	583	670,345	528	514,246
Self-contained portable	262	183,451	290	189,383
Miscellaneous	81	50,962	90	39,510
Total	6,310	6,631,779	8,628	9,527,068
Marine				
Water-tube	86	542,002	35	156,453
Pipe	2	2,236	4	3,892
Scotch	37	26,643	52	50,841
2- and 3-flue	....	.....	2	1,35[illegible]
Miscellaneous	7	3,928	4	4,248
Total	132	574,809	97	216,784
Grand total	6,442	7,206,588	8,725	9,743,852

Sales of mechanical stokers for the first half of the year show a similar loss, with totals of 564 stokers with a capacity of 184,575 hp., compared with 812 of 293,221 hp. for the first six months of 1929. Shipments of oil burners, however, gained slightly, with 24,928 against 23,810 for the first half of last year. New orders for pulverized-fuel equipment for the six months ended June 30 amounted to 243 units with a total capacity of 1,413 tons per hour. As this is the first year that statistics have been compiled on sales of pulverized-fuel equipment, there are no figures available for comparison with other years.

California Towns Talk Municipal Ownership

Large quantities of waste natural gas available from the Kettleman Hills oil fields in the San Joaquin Valley of California has caused three towns to start investigation of gas burning steam plants and municipal distribution. Only July 16 the City Council of Tulare, Calif., appropriated $12,500 for retaining an expert to look into the economy of creating a utility district, installing a steam-electric plant to burn natural gas from a well on which the city has an option, and to acquire a municipal distribution system.

Similar movements are under way in Fresno and Hanford, Calif. Tulare and Hanford are served with electricity by the Southern California Edison Company, Ltd., and Fresno by the San Joaquin Light & Power Company. The Pacific Gas & Electric Company supplies natural gas to Fresno, and the Southern California Gas Company supplies Hanford and Tulare.

British Output Increases

The official returns rendered to the British Electricity Commissioners show that 709,000,000 kw.-hr. of electricity was generated by central stations in the United Kingdom during the month of June, 1930, as compared with 694,000,000 in the coresponding month of 1929, an increase of about 2.2 per cent. During the six months of 1930 up to the end of June, the total amount of electricity generated by Central Stations was 5,381,000,000 kw.-hr., compared with 5,098,000,000 for the corresponding period of 1929, representing an increase of 5.5 per cent.

News of Canada

Diversion accomplished at Chute-a-Caron by sinking huge concrete block across river

DIVERSION of the swift Saguenay River to a newly excavated channel at the power plant now under construction at Chute-a-Caron in northeastern Quebec was successfully completed on July 23. As ordinary methods of diversion would not suffice on account of the river flow of 40,000 sec.-ft. at a velocity of twenty feet per second, a novel method of closing off the river, proposed by James W. Rickey, hydraulic engineer of the Aluminum Company of America, was adopted.

During the early stages of construction of the dam, a diversion channel which ultimately will serve as an intake channel and tailrace was excavated parallel to the river at the dam site. Meanwhile the dam was built out from both sides of the river, leaving only the deep and narrow river gorge open. When the time came to close the river, diversion was accomplished by tipping into it a precast concrete dam, 92 ft. long by 45 ft. wide, containing 5,400 cu.yd. of concrete which had been built in a vertical position on an island in the river and balanced on two piers, as shown in the accompanying illustration. The face toward the channel was contoured to fit the river bottom. The pier on the side toward the channel was blasted away and the precast dam rolled over the cylindrical part of the remaining pier and fell into place.

The mass, weighing 11,000 tons, fell into 30 ft. of swiftly moving water and came to rest within one inch of the calculated position. The water cushioned the fall so completely that the huge block of concrete settled gently into place without being broken. It fits the bottom closely and forms a very economical and satisfactory cofferdam.

The work is being done by the Alcoa Power Company, under the direction of C. P. Dunn, chief engineer.

The concrete diversion dam just before it was tipped into the Saguenay River at Chute-a-Caron

Attending Third Congress for Applied Mechanics

J. M. Lessells, Dr. J. P. DenHartog, Dr. S. Timoshenko, and R. E. Peterson, all of the Westinghouse research laboratories, will attend the third International Congress for Applied Mechanics to be held in Stockholm, Sweden, the week of Aug. 25.

Mr. Lessells has been honored as one of the three engineers to officially represent the United States at the congress. He is in charge of the mechanics division, Westinghouse research laboratories. Dr. DenHartog, after the congress, will spend a year at Gottingen, Germany, studying under Dr. L. Prandtl, one of the world's greatest authorities on mechanics.

Dr. Timoshenko, Dr. DenHartog, and Mr. Peterson will present papers of their own before the congress, and, with Mr. Lessells, will present papers by the following other Westinghouse engineers: Dr. A. Nadai, G. B. Karelitz, Dr. O. Tietjens, J. Ormondroyd, Morris Stone, B. F. Langer, and J. P. Shamberger.

Leipzig Trade Fair Will Attract Large Throng

The historic Leipzig Trade Fair, comprising 8,500 exhibits from 24 countries, and attended by buyers from 72 countries, will be held from Aug. 31 to Sept. 5 this year. For 700 years this German enterprise has regularly attracted merchants from all over the world, until now more than 185,000 buyers meet there to purchase their needs.

All types of apparatus in every industrial field will be represented among the exhibits. The newest products of five continents will be attractively displayed in 61 "palaces" conveniently grouped to facilitate inspection. American manufacturers will be represented by more than 100 important exhibits.

Detailed information concerning every department of the fair may be obtained by addressing the Leipzig Trade Fair, Inc., 11 West 42d St., New York City.

College of Engineering at California University

Under a reorganization of the engineering courses of the University of California the interests of civil, electrical, and mechanical engineering will be administered by the faculty of a College of Engineering, of which Professor Charles Derleth, Jr., has been appointed dean. The College of Engineering will conduct four-year curricula separately in civil, electrical, and mechanical engineering, each leading to the B.S. degree. These may be followed by graduate opportunities for students who wish to remain longer than four years. Graduate study may be pursued for one year, leading to a M.S. degree, or for longer periods, leading to the engineer's degree or the Ph.D.

By administering these engineering groups by one faculty, with one dean, it is intended to offer to students the option to remain more than four years, thereby combining to a fuller degree simultaneous studies in civil, electrical, and mechanical sciences. In this way students may remain five years or even six years, receiving the B.S. degree in a combination of engineering subjects.

How's Business?

EXACTLY a year after business scaled the peak of its 1929 boom it is reaching its low in the subsequent depression. Our index has dropped again, from 94.4% of normal to 91.1%, as compared with the high point of 114.6% a year ago, and will probably fall farther next week. August will bring definite signs of improvement, beginning with the basic industries, and as we move further into the last half the paralyzing pessimism of recent months will find less to feed on in the comparative records of this year and last. Although the usual seasonal decline of building contracts has set in rapidly, abundant security issues for public and private work in the past quarter will cushion the decline, and the contracts placed so far will carry over into business activity during the rest of the year. While general trade is beginning to sag under the pressure of months of impaired purchasing power and business confidence, industrial activity and railroad movement of merchandise show signs of revival under the stimulus of depleted stocks. — *The Business Week*, Aug. 6.

Obituary

ALLEN HAZEN, outstanding authority on hydraulics, water supply and sewage disposal, died of a heart attack on July 26 at Miles City, Mont., while on a vacation trip with his daughter. Born in Vermont in 1869, Mr. Hazen was graduated from the New Hampshire College of Agriculture and Mechanic Arts in 1886. Through his basic studies in water supply and filtration he became a leader of thought in hydraulic and sanitary engineering. He constructed the first slow sand filter plant with continuous filtration in the United States. He was the author of numerous books on subjects relating to his chosen profession and took an active part in the affairs of the American Society of Civil Engineers.

Personals

R. M. BOYKIN, for many years associated with the Puget Sound Power & Light Company and affiliated companies in the Northwest, and more recently occupying the position of manager of the central district of the Puget Sound company in Seattle, has resigned his position with that company effective in August to accept a position with the Electric Bond & Share Company, New York. It is understood that Mr. Boykin's assignment in that company will closely associate him with Frank Silliman, Jr., a vice-president whose activities are largely centered on various properties in the states of Montana, Washington, and Oregon, receiving some measure of Bond & Share supervision.

W. B. PALMER of Bridgeport, Conn., announces the organization of the W. B. Palmer Engineering Company, specializing in hydraulic and municipal engineering, paying special attention to water-power development. Mr. Palmer, who was graduated from Sheffield Scientific School in 1876, for the past 30 years has been in private practice.

FRANK W. MARTIN'S title as statistician with Sargent & Lundy, Inc., has been changed to research engineer.

T. H. TUTWILER, active head of the Memphis Power & Light Company of Memphis, Tenn., since 1923 and an official of the company for more than 25 years, has resigned as president. W. D. KYSER, of Wilson, Tenn., has been elected to fill the vacancy. Mr. Tutwiler continues his connection with the organization as a member of its board of directors.

J. M. HARLEY has been promoted from assistant superintendent to superintendent of power plant of the Dallas Power & Light Company, Dallas, Texas. F. H. ELMORE, JR., formerly division head in charge of the electrical division of the company, has been made assistant superintendent of power plant.

FRED T. WHITING, of Chicago, former industrial manager of the Westinghouse Machine Company, has been appointed assistant manager of the northwest district of the Westinghouse Electric & Manufacturing Company to succeed N. G. SYMONDS, who recently became commercial vice-president of the company.

GEORGE W. W. CORNMAN, treasurer and manager of the service department of the Brown Instrument Company, will retire from business on Aug. 8. Mr. Cornman has been associated with the instrument business for 35 years, formerly being secretary and treasurer of the Keystone Electrical Instrument Company. R. C. KENNAN has been appointed manager of the service department to fill the vacancy.

Business Notes

THE DIESEL ENGINEERING CORPORATION, LTD., has been formed in California with an authorized capitalization of $500,000, to manufacture and market Diesel engines and appliances under patents held by Diesel Motors, Inc., of Nevada. Officers named are president, Miles B. Nabors, and secretary, Ernest A. Wilson. The company's headquarters are at 820 Mills Building, San Francisco.

CHASE BRASS & COPPER COMPANY, Waterbury, Conn., announces the opening of a new warehouse at 855 North Avenue West, Pittsburgh, Pa.

THE SUPERHEATER COMPANY has moved from Room 801 to Room 1325 of the Peoples Gas Building, 122 South Michigan Blvd., Chicago, Ill.

SIMPLEX VALVE & METER COMPANY, Philadelphia, Pa., announces the appointment of Goldsborough & Vansant, Inc., Farmers Bank Building, Pittsburgh, Pa., as district representative for the Pittsburgh territory.

STANDARD MOTOR CONSTRUCTION COMPANY, Jersey City, N. J., announces the appointment of L. S. Deves as general sales manager.

INTERNATIONAL FILTER COMPANY, Chicago, Ill., and associated companies, International Water Softener Company and General Zeolite Company, announce that expansion of their manufacturing facilities required the removal of their general offices and engineering departments from Plant No. 1 at 333 West 25th Place to larger quarters in the Buckingham Building, 59 East Van Buren St., Chicago.

MCCLAVE-BROOKS COMPANY, Scranton, Pa., announces the appointment of the Eagle Oil & Supply Company, 74 West 2nd St., South Boston, Mass., as exclusive representative in Maine, New Hampshire, Vermont, Massachusetts and Rhode Island. Announcement is also made of the appointment of George H. Vincent, 818 Chapel St., New Haven, Conn., as exclusive representative in the state of Connecticut.

GENERAL REFRACTORIES COMPANY, Philadelphia, Pa., announces the opening of a new district sales office in the Empire Building, Birmingham, Ala., with Walter S. Stapler in charge.

AMERICAN TANK AND EQUIPMENT COMPANY, Oklahoma City, Okla., announces the completion of its new factory, which is one of the largest in the country of all-welded construction.

POWER PLANT ENGINEERING COMPANY, a division of the Petroleum Heat & Power Company, New York City, is building a new sales and service and warehousing building at East 13th and Burnside St., Portland, Ore. The building is 50 x 90 ft. of concrete.

▼

COMING CONVENTIONS

American Society of Mechanical Engineers. Annual meeting in New York City, Dec. 1-5. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Institute of Electrical Engineers. Annual Pacific Coast convention at Portland, Ore., Sept. 2-5. District meeting at Philadelphia, Pa., Oct. 13-15. District meeting at Louisville, Ky., Nov. 19-22. Secretary, F. L. Hutchinson, 33 West 39th St., New York City.

National Association of Power Engineers. Annual convention and exhibition of power machinery at the Cleveland Auditorium, Cleveland, Ohio, Sept. 8-13. Secretary, Fred W. Raven, 417 South Dearborn St., Chicago, Ill.

National Association of Practical Refrigerating Engineers. Annual convention and exhibition at the Hotel Peabody, Memphis, Tenn., Nov. 11-14. Secretary, Edward H. Fox, 5707 West Lake St., Chicago, Ill.

National Power Show. Grand Central Palace, New York City, Dec. 1-6. Manager, Charles F. Roth, Grand Central Palace, New York City.

Universal Craftsmen Council of Engineers. Annual convention at the Hotel Kimball, Springfield, Mass., Aug. 5-8. Secretary, T. H. Jones, 33 Linden Ave., Cherrydale, Va.

▼

Trade Catalogs

CONTROLLERS—The General Electric Company, Schenectady, N. Y., has just issued the 1930 edition of its Industrial Control Catalog, GEA-606B, listing a complete line of starters, regulators, controllers, switches, resistors and accessories. Other recent bulletins of the company on switches include: GEA-913C on automatic time switches; GEA-189B on automatic switching equipment; GEA-735B on high-voltage, horn-gap switches; GEA-1159A on trip-free air circuit breakers; GEA-1062A on line contacts for outdoor disconnecting switches; and GEA-93G on line-type lightning arresters.

STEAM TRAPS—"On Correct Trap Design" is the title of a 16-page, illustrated booklet just issued by the McAuley Automatic Trap Company, Imperial Power Building, Pittsburgh, Pa., which clearly sets forth the functions of a steam trap and the fundamentals of its design.

PUMPS—A new 30-page, fully illustrated, bulletin of the Peerless Pump Company, Los Angeles, Calif., describes deep-well turbine pumps for lifting water from any practical depth with capacities from 30 to 7,000 gal. per minute for wells from 6 to 18 in. in diameter.

WELDING—A new publication describing Flex-Arc welding sets, manufactured by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is designated by that company as Leaflet 20390-B. A feature of these gas engine-driven welders is the "Flexactor," a reactance which produces a steady, uniform and flexible arc at all currents.

CARBON BRUSHES—A booklet that should prove of value to users of motor and generator brushes and other carbon products has just been issued by the Speer Carbon Company, Saint Marys, Pa. Under the title "Speer Carbon Products" this 55-page publication embodies a thorough discussion of brush characteristics, data on the selection of brush grades and service recommendations.

▼

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	At Mine, for Shipment to	Price per Ton
Navy Standard	New York	$2.10 @ $2.30
Kanawha	Cincinnati	.90 @ 1.10
Smokeless	Cincinnati	1.75 @ 2.00
Smokeless	Chicago	2.00 @ 2.25
West Kentucky	Louisville	.85 @ 1.25
Steam	Pittsburgh	1.50 @ 1.60
Gas Slack	Pittsburgh	.90 @ 1.10
Big Seam	Birmingham	1.60 @ 1.75

Anthracite (Gross Tons)	At Mine, for Shipment to	Price per Ton
Buckwheat	New York	$3.00
Barley	New York	1.15 @ 1.50

FUEL OIL

New York—July 31, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.75c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 6@6.50c. per gal.

St. Louis—July 30, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.345 per bbl., or 42 gal.; 26@28 deg., $1.470 per bbl.; 28@30 deg., $1.545 per bbl.; 30@32 deg. $1.625 per bbl.; 32@36 deg., gas oil, 4.15c. per gal.; 38@40 deg., distillate, 4.65c. per gal.

Pittsburgh — July 22, f.o.b. local refinery, 34@36 deg., fuel oil, 3.12½c. per gal.; 36@40 deg., 3.25c.

Philadelphia—July 12, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 18 deg. plus, $1.475@$1.525 per bbl.; 23@27 deg., $2.00@$2.05 per bbl.

Cincinnati — July 28, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5.25c. per gal.; 26@30 deg., 5.5c. per gal.; 30@32 deg., 5.75c. per gal.

Chicago—July 11, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 65c. per bbl.; 26@30 deg., 77.5c. per bbl.; 30@32 deg., $0.95 per bbl.

Boston—July 29, tank-car lots, f.o.b., 12@14 deg., Baumé, .033c. per gal.; 28@32 deg., 5c. per gal.

Dallas—July 26, f.o.b. local refinery 26@30 deg., $1.10 per bbl. or 42 gallons

New Plant Construction

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Pasadena—City is having preliminary plans prepared for the construction of a municipal light plant at Glenarm St. between Fairoaks and Raymond Aves. Estimated cost $150,000. Bennett & Haskell, 311 First Trust Bldg., are engineers.

Calif., San Francisco—Pacific Gas & Electric Co., 245 Market St., will build a 3 story substation at 19th and San Carlos Sts. Estimated cost $85,000.

Calif., Watsonville — Apple Growers' Cold Storage Co., awarded contract for addition to cold storage plant, to P. T. Walstrom, 30 West Lake Ave. $49,950.

Conn., Norwalk — Hain Bros., Meadow St., awarded contract for a 1 story, 55 x 150 ft. ice manufacturing plant to T. Lanese, 190 Calhoun Ave., Bridgeport. Estimated cost $40,000.

Conn., Plainville—Town, L. Staple, 74 East St., awarded contract for the construction of a central heating plant, to J. G. Simpson, Webster St. Estimated cost $25,000.

Ill., Dupo — City voted $98,000 bonds for sewage treatment work, including pumping station, etc. Schwaab & Shepard, Faulstitch Bldg., Alton, are engineers.

Ind., Hammond—State Line Generating Co., awarded contract for a 194 x 380 ft. addition to electric generating station to Herlihy-Mid-Continent Construction Co., 228 North LaSalle St., Chicago, Ill.

Ind., South Bend—Indiana & Michigan Electric Co., awarded contract for a 40 x 60 ft. power sub-station at Colfax and Kaley Sts., to John Nelson Co., 712 North Niles St. Estimated cost $43,000.

Ia., Charles City—Iowa Public Service Co., c/o G. V. Lonnecker, Supervising Engr., Commercial and West Park Ave., Waterloo, Ia., awarded contract for a 49 x 65 ft. addition to boiler plant to Currie Construction Co., 180 West First St., Waterloo. Estimated cost $50,000.

Ia., Randolph—City, M. Fichter, Clk., awarded contract for tubular well, pump house, pump and motor in connection with waterworks to Interstate Machinery Co., 1006 Douglas St., Omaha, Neb. Estimated cost $15,789. Other contracts awarded.

Kan., Kansas City—City plans extensions and improvements to power and light plant. Burns & McDonnell Engineering Co., 400 Interstate Bldg., Kansas City, Mo., are engineers.

Mass., Boston — Boston Financial Interests, c/o W. J. McDonald, awarded contract for the construction of a 40 story bank, office and stores building, etc. on Stuart St. to H. K. Ferguson Co., Hanna Bldg., Cleveland, O. Estimated total cost $30,000,000.

Mass., East Long Meadow—Central Massachusetts Electric Co., Palmer, is having plans prepared for the construction of a 1 story automatic power sub-station. Estimated cost $50,000. Private plans.

Mass., Lawrence—Meadow Brook Laundry, 17 North Methuen St., will build a 1 story power house. Estimated cost $40,000 including equipment. H. Petzold, Bay State Bldg., is engineer. Work will be done by separate contracts.

Mass., Lexington—E. J. Baskin, East St., will build a 50 x 300 ft. greenhouse including boiler house. Estimated cost $40,000. Private plans. Work will be done by separate contracts.

Mass., Lynn—City, D. Dineen, City Hall, received lowest bid for the construction of a police station, garage, boiler house and heating plant from W. T. Dineen Construction Co., Memorial Park. $110,000.

Mass., Springfield—Springfield Hospital, 759 Chestnut St., will receive bids until Aug. 6 (extended date) for a 7 story addition to hospital and service building including steam heating and ventilation systems, etc. at North Chestnut and Springfield Sts. Estimated cost $1,000,000. Stevens & Lee, 45 Newbury St., Boston, are architects.

Mich., Detroit—Bd. of Education, 1354 Broadway Ave., C. A. Gadd, Bus. Mgr., will receive bids until Aug. 6 for the construction of a 2 story school including separate power house on Bolleyn Ave. Estimated cost $200,000. A. H. Gould & Son, 602 Empire Bldg., are architects.

Minn., Duluth—Duluth Steam Corp., had plans prepared for the installation of a central steam heating plant. Estimated cost $1,250,000. W. J. Sullivan, 408 Palladis Bldg., is engineer.

Mich., Hattiesburg — City awarded contract for the construction of a filter plant, pumping station, etc. in connection with waterworks to A. H. Guion & Co., Gastonia, N. C. $201,900. Also switchboard installation, etc. for pumping station to Cetnral Electric Co., Hattiesburg. $19,740.

N. J., Passaic—Public Service Electric & Gas Co., 80 Park Pl., Newark, will build a 1 story electric switching station at Columbia Ave., here. Estimated cost $40,000. Private plans. Work will be done by separate contracts.

N. J., Perth Amboy—J. Eherson, 370 Lexington Ave., New York, N. Y., Archt., will receive bids about Sept. 15 for the construction of a theatre building including steam heating and ventilating systems at Smith and Maple Sts. here for Warner Bros. Pictures, Inc., H. M. Warner, Pres., 321 West 44th St., New York. Estimated cost $1,000,000.

Pa., Ambridge—Briola Bros., 10th Ave., is receiving revised bids for the construction of an ice plant at 10th and Glenwood Sts. Estimated cost $60,000. Private plans.

Pa., Pittsburgh—Allegheny Co. Comrs., R. G. Woodside, County Comptroller, will receive bids until Aug. 5, for the construction of a county office building, including steam heating system, etc. Estimated total cost $3,540,000. S. L. Rousch, 519 Smithfield St., is architect.

Tex., El Dorado—West Texas Utilities Co., c/o T. A. W. Stern, Abilene, will build a 30 ton ice and cold storage plant, here. Estimated cost $32,000. Private plans. Work will be done by day labor.

Tex., Dallas — Dallas Power & Light Co., Interurban Bldg., plans to expend $1,258,243 during next two years for extension and improvements to power transmission line.

Tex., Huntsville—State Penitentiary System, will soon receive bids for mechanical improvements to include remodeling of power plant, etc. Estimated cost $75,000. L. D. Royer, Smith-Young Tower, San Antonio, is engineer.

Tex., Richland Springs — Richland Springs Cavern, plans resort project to include reservoir, 30,000 w. power plant, 25 hp. engine, water well pump, etc. Private plans.

Tex., Sugarland — State Prison Commission c/o F. Tiller, Secy., Rosenberg, is having preliminary plans prepared for the construction of a power plant, here. Estimated cost $25,000. F. E. Giesecke, A. & M. College, College Station, is architect and L. D. Royer, Smith-Young Tower, San Antonio, is engineer.

Vt., Charlestown—Village of Barton, is receiving bids for additions and alterations to municipal light and power plant. Estimated cost $40,000. I. W. Jones & Co., Milton, N. H., are engineers.

Equipment Wanted

Boiler Stokers, Coal and Ash Handling Equipment, etc.—Skillman, N. J.—Dept. of Institutions & Agencies, State Office Bldg., Trenton, will receive bids until Aug. 15 (extended date) for furnishing and installing boiler stokers, coal and ash handling equipment, conduits, smokestack, etc. for power house at State Village for Epileptics. Estimated cost $25,000.

Engine—Saugus, Mass.—M. McDonough Co., 821 Broadway, is in the market for a 10 hp. two cylinder gas engine.

Mechanical Equipment, Boilers, etc.—Jersey City, N. J.—Bd. of Commissioners, City Hall, will receive bids until Aug. 8, for furnishing and installing mechanical equipment and boilers for power plant at Jersey City Hospital.

Motor—Brockton, Mass.—Doyle Shoe Co., W. E. Doyle, Purch. Agt., is in the market for a 25-30 kw., d.c. motor.

Motor Geneartor Sets, Motors, and Control Equipment—Indianapolis, Ind.—Bd. of Health, H. S. Leonard, Pres., will receive bids until Aug. 11, for motor generator sets, motors and control equipment in connection with new light and power plant at Indianapolis City Hospital.

Pump—Chino, Calif.—City Council, will receive bids Aug. 19 for furnishing and installing a 700 g.p.m. turbine pump for well No. 1 for proposed waterworks improvements.

Pumping Units—Pittsburgh, Pa.—City, E. G. Lang, Dir. Public Works, will receive bids until Aug. 12, for pumping units and accessories for Herron Hill pumping station.

Pumps, Motors, etc.—Crescent, Okla.—City is in the market for a 70 g.p.m. triplex pump, 350 g.p.m. centrifugal pump, one 10 and one 30 hp. motors, etc. for waterworks.

Industrial Projects

Calif., Richmond—Ford Motor Car Co., 3674 Schaefer Rd., Dearborn, Mich., awarded contract for the construction of a 320 x 950 and 160 x 950 ft. assembly plant including 55 x 80 ft. boiler plant, 62 x 113 ft. oil house, etc. here, to Clinton Construction Co., 923 Folsom St., San Francisco, Calif. $3,500,000.

Conn., Bridgeport—Heppenstall Forge Co., 95 Howard Ave., awarded contract for the construction of a factory to Hewlett Co., 886 Main St. Estimated cost $40,000.

Md., St. Helena—Chemical & Pigments Corp., awarded contract for two 1 and 2 story, 50 x 110 ft. factory buildings to Price Construction Co., Maryland Trust Bldg., Baltimore.

Mass., Everett (Br. Boston)—Mystic Iron Works, 250 Stuart St., Boston, will build addition to boiler house on Dexter St. here. Estimated cost $40,000. Private plans. Work will be done by separate contracts.

Mass., West Springfield—Strathmore Paper Co., Mittineague, had plans prepared for the construction of a paper plant. Estimated cost $125,000. L. R. Howe, c/o owner, is architect.

N. J., Belleville—Wallace & Tierman Co. Inc., 11 Mill St., awarded contract for the construction of a 4 story, 78 x 170 ft. addition to factory for the manufacture of chlorine apparatus at Schuyler Ave. and Terrace Pl. to Mahoney Troast Co., 657 Main Ave., Passaic. Estimated cost $150,000.

N. J., Bound Brook — Bakelite Corp., 247 Park Ave., New York, N. Y., awarded contract for the construction of a 1, 2 and 3 story, 405 x 410 ft. factory, including garage, machine shop, manufacturing building, power house, pump house, switch house and storage building at River Rd., here, to Karno-Smith Co., Inc., Broad St. Bank Bldg., Trenton. Estimated cost $150,000.

N. Y., Buffalo — Ford Motor Co., 3674 Schaefer Rd., Dearborn, Mich., will receive bids until Aug. 4, for the construction of a 1 and 2 story, 420 x 1,000 ft. assembly plant including machine shop, combination boiler house and power plant, etc. at Hamburg Turnpike, here. A. Kahn, 1000 Marquette Bldg., Detroit, Mich., is architect.

N. Y., Cortland — Brewer-Titchener Corp., manufacturers of hardware for electrical trade, awarded contract for a 1 story factory to The Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost $100,000.

N. Y., Leroy—Lapp Insulator Co., awarded contract for the construction of a 1 story factory to H. K. Ferguson Co., Hanna Bldg., Cleveland, O. Estimated cost $40,000.

O., Cleveland—American Steel & Wire Co., J. S. Keefe, Pres., Rockefeller Bldg., awarded masonry contract for a 1 story, 80 x 700 ft. addition to steel mill at East 42nd St. and Harvard Ave. to Stevens Construction Co., Erie Bldg. Estimated cost $150,000.

O., Marion—Marion Vault Mfg. Co., is having plans prepared for the construction of a 1 story factory. Estimated cost $40,000. Private plans.

Pennsylvania—Jones & Laughlin Steel Corp., Ross St., Pittsburgh, plans extensions and improvements to steel mills at Pittsburgh and Aliquippa. Estimated cost approximately $20,000,000.